REGION D
EVALUATIONS OF ALTERNATIVE WATER MANAGEMENT STRATEGIES
FOR MEETING PROJECTED WATER SUPPLY NEEDS
TO YEAR 2070

# CASS COUNTY

*WUGs:*

City of Queen City
Manufacturing, Cass County

## EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF QUEEN CITY

**Description of Water User Group:**

The City of Queen City provides water service in Cass County. The City's population is projected to be 1,701 in 2020 and 1,714 in the year 2070. The City primarily utilizes groundwater supply from the Carrizo-Wilcox Aquifer, although it has the capability to use water supply from the City of Texarkana from Lake Wright Patman that it has used in the past. The City is not expected to have shortages as sufficient groundwater supplies are projected over the 2020 – 2070 planning period. However, the City's full demands have been considered in evaluation of strategies for the purposes of the 2021 Region D Plan as the City's demands were included as part of the evaluation of strategies within the Riverbend WRD's Regional Water Master Plan.

**Water Supply and Demand Analysis:**

| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Population** | 1,701 | 1,714 | 1,714 | 1,714 | 1,714 | 1,714 |
| **Projected Water Demand** | 258 | 251 | 244 | 243 | 243 | 243 |
| **Current Water Supply** | 269 | 269 | 269 | 269 | 269 | 269 |
| **Projected Supply Surplus (+) / Deficit (-)** | **11** | **18** | **25** | **26** | **26** | **26** |

**Evaluation of Potentially Feasible Water Management Strategies:**

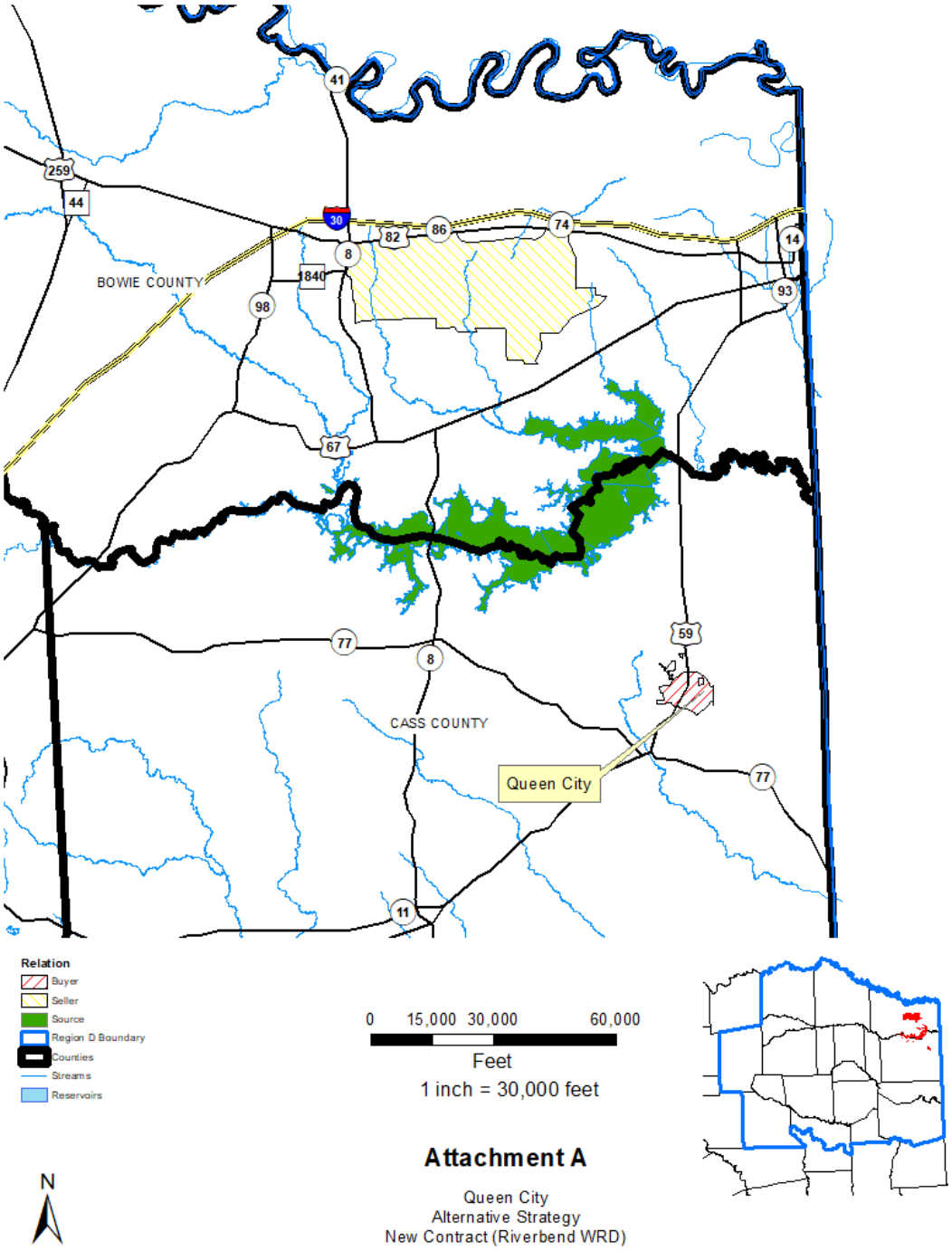
There were five alternative strategies considered to meet the City's water supply shortages as summarized in the Table below. Advanced conservation was not considered because the per capita use per day would be less than the 140 gpcd threshold set by the water planning group. Reuse is not a feasible option because water supply is mainly used for public consumption. Existing groundwater supply is sufficient to meet the City's needs, and is expected to continue to meet projected future demands for the City. Voluntary reallocation of manufacturing supply was identified in order to account for the fact that the Riverbend WRD Regional Master Plan indicates that supply could be provided via diversion of supply for GPI at Lake Wright Patman, a part of the Cass Manufacturing WUG, thus the amount for voluntary reallocation does not affect the 120,000 ac-ft/yr of contracted supply between Texarkana and GPI. Further, a request was submitted by Riverbend Water Resources District to consider a new 2.5 MGD package water treatment plant and transmission line for supply from Wright Patman Reservoir. Thus, a new contract with Texarkana/Riverbend has been considered herein.

| Strategy | Firm Yield (ac-ft) | Total Capital Cost | Total Annualized Cost | Unit Cost | Environmental Impact |
|---|---|---|---|---|---|
| Advanced Water Conservation | | | | | |
| Water Reuse | | | | | |
| Ground Water | | | | | |
| Voluntary Reallocation (from Cass Manufacturing) | **251** | **$0** | **$0** | **$0** | **1** |
| New Contract | **251** | **$0** | **$121,000** | **$482** | **1** |

**Identified Alternative WMS and WMSP:**

| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Voluntary Reallocation (from Cass Manufacturing)** | **0** | **251** | **244** | **243** | **243** | **243** |
| **New Contract (ac-ft/yr)** | **0** | **251** | **244** | **243** | **243** | **243** |

The alternative WMS identified for the City of Queen City is for a new contract surface water purchase from Texarkana/Riverbend WRD contingent upon voluntary reallocation of supply from Cass Manufacturing and Riverbend WRD's recommended strategy for a new 2.5 MGD package water treatment plant and transmission line.




## Attachment A

Queen City
Alternative Strategy
New Contract (Riverbend WRD)

***Cost Estimate Summary***
***Water Supply Project Option***
***September 2018 Prices***

***Queen City - New Contract with Riverbend WRD***

***Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018***

| *Item* | *Estimated Costs for Facilities* |
|---|---|
| **ANNUAL COST** | |
| Operation and Maintenance | |
| Intakes and Pump Stations (2.5% of Cost of Facilities) | $0 |
| Dam and Reservoir (1.5% of Cost of Facilities) | $0 |
| Water Treatment Plant | $0 |
| Advanced Water Treatment Facility | $0 |
| Pumping Energy Costs (0 kW-hr @ 0.08 $/kW-hr) | $0 |
| Purchase of Water (251 acft/yr @ 482.28 $/acft) | $121,000 |
| **TOTAL ANNUAL COST** | **$121,000** |
| | |
| **Available Project Yield (acft/yr)** | 251 |
| **Annual Cost of Water ($ per acft), based on PF=1** | $482 |
| **Annual Cost of Water After Debt Service ($ per acft), based on PF=1** | $482 |
| **Annual Cost of Water ($ per 1,000 gallons), based on PF=1** | $1.48 |
| **Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1** | $1.48 |

*JMP* *10/2/2019*

REGION D
EVALUATIONS OF ALTERNATIVE WATER MANAGEMENT STRATEGIES
FOR MEETING PROJECTED WATER SUPPLY NEEDS
TO YEAR 2070

# HOPKINS COUNTY

*WUGs:*

Brinker WSC
City of Cumby
Hopkins County Irrigation
Hopkins County Livestock
Martin Springs WSC
Miller Grove WSC
Hopkins County Mining

**EVALUATION OF ALTERNATIVE WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF BRINKER WATER SUPPLY CORPORATION IN HOPKINS COUNTY**

**Description of Water User Group:**

Brinker WSC provides water service in Hopkins County. It is projected that the users in the WUG will have a shortage in 2050. The WUG population is projected to be 2,369 by 2020 and increases to 4,198 by 2070. The WSC utilizes groundwater from the Carrizo-Wilcox aquifer and has a contract for water supply with City of Sulphur Springs for 77 ac-ft/yr. Brinker WSC is projected to have a deficit of 12 ac-ft in 2050, increasing to a deficit of 83 ac-ft by 2070.

**Water Supply and Demand Analysis:**

| | **2020** | **2030** | **2040** | **2050** | **2060** | **2070** |
|---|---|---|---|---|---|---|
| **Population** | 2,369 | 2,737 | 3,071 | 3,456 | 3,825 | 4,198 |
| **Projected Water Demand** | 253 | 281 | 307 | 341 | 377 | 413 |
| **Water Demand from other entities** | 0 | 0 | 0 | 0 | 0 | 0 |
| **Current Water Supply** | 329 | 328 | 328 | 329 | 330 | 330 |
| **Projected Supply Surplus (+) / Deficit (-)** | **76** | **47** | **21** | **-12** | **-47** | **-83** |

**Evaluation of Potentially Feasible Water Management Strategies:**

Five alternative strategies considered to meet the WSC's water supply shortages as summarized in the table below. Advanced conservation was not selected because the per capita use per day was less than the 140 gpcd threshold set by the water planning group. Reuse is not a feasible option because water supply is mainly used for public consumption. Additional use of groundwater has been identified as a likely source of water for Brinker WSC in Hopkins County; however, projected needs exceed the availability of groundwater in the Sulphur basin based on the modeled available groundwater (MAG) estimates and review of available information from a local hydrogeological assessment. A potential regionalization strategy is the Wood County Pipeline where in the City could construct an 8 inch diameter pipeline that ties into a branch of the Wood County Pipeline near Sulphur Springs. Purchase of additional surface water from Sulphur Springs Lake under the existing contract from the City of Sulphur Springs was also considered.

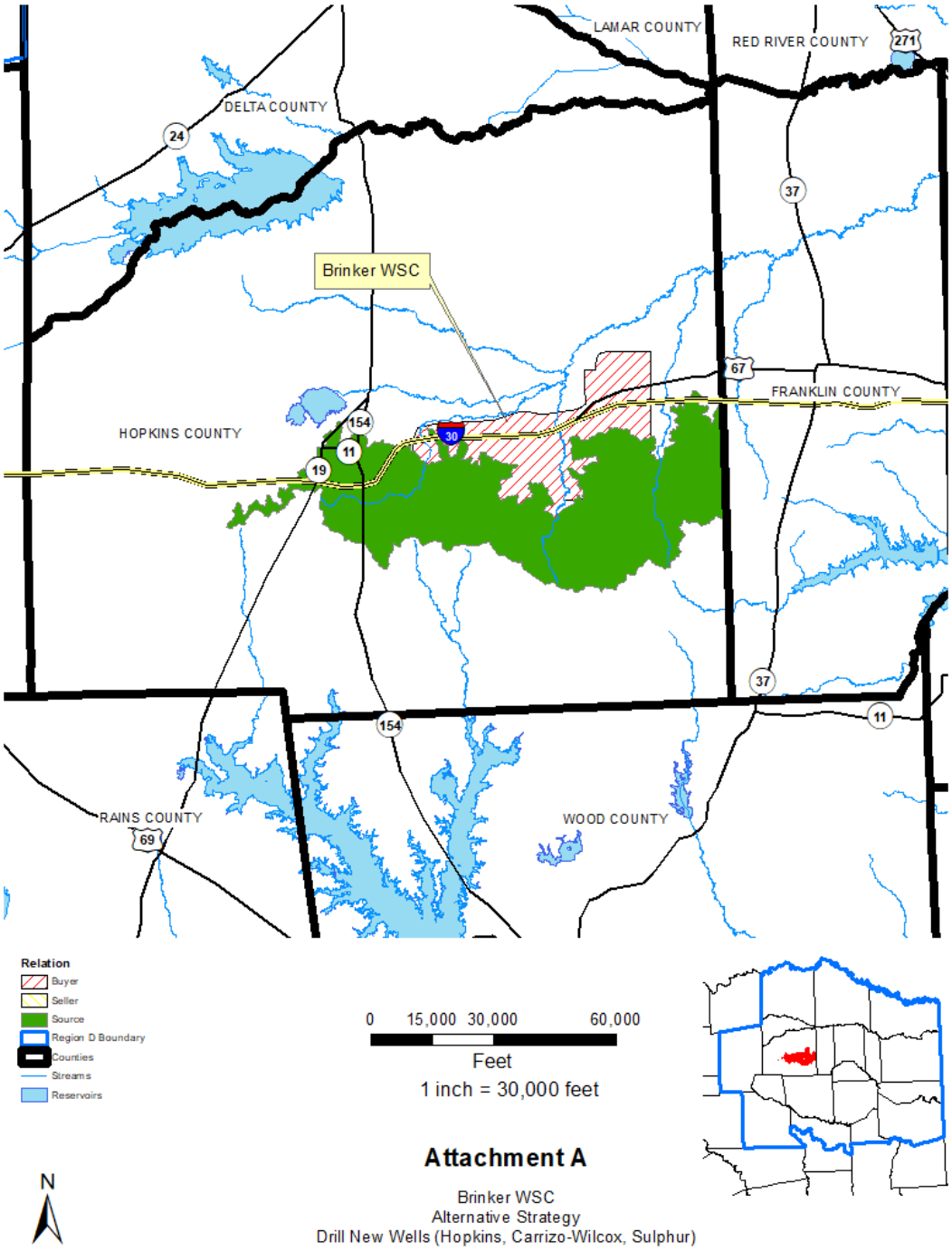
| **Strategy** | **Firm Yield (ac-ft)** | **Total Capital Cost** | **Total Annualized Cost** | **Unit Cost** | **Environmental Impact** |
|---|---|---|---|---|---|
| Advanced Water Conservation | | | | | |
| Water Reuse | | | | | |
| Drill New Wells (Carrizo-Wilcox, Sulphur Basin) | **83** | **$1,405,000** | **$175,000** | **$2,108** | **1** |
| Increase Existing Contract w/ Sulphur Springs | **83** | **$0** | **$95,000** | **$1,145** | **1** |
| Wood County Pipeline Tie-in | **83** | **$3,567,000** | **$409,000** | **$4,928** | **2** |

**Identified Alternative WMS and WMSP:**

| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Drill New Wells (Carrizo-Wilcox, Sulphur Basin) (ac-ft/yr)** | 0 | 0 | 0 | 12 | 47 | 83 |
| **Wood County Pipeline Tie-in** | 0 | 0 | 0 | 12 | 47 | 83 |

Two alternative water management strategies have been identified for Brinker WSC.
The first identified alternative water management strategy for Brinker WSC to meet their projected deficit of 12 ac-ft/yr in 2050 and 83 ac-ft/yr in 2070 would be to construct three additional water wells similar to their existing wells just prior to 2050. The recommended supply source will be the Carrizo-Wilcox Aquifer in the Sulphur Basin in Hopkins County. One well with rated capacity of 75 gpm would provide approximately 40 acre-feet each. The Carrizo-Wilcox Aquifer is projected to have sufficient supply availability to meet the needs of Brinker WSC for the planning period.

A second alternative water management strategy for Brinker WSC identified to potentially meet their projected water needs is the Wood County Pipeline Strategy, of which an Alternative Water Management Strategy Project is for Brinker WSC to construct a tie-in to the proposed Wood County Pipeline. While this strategy is contingent upon the development of the Wood County Pipeline and Well Field, Brinker WSC could construct an 8” pipeline to tie into the proposed raw water pipeline and deliver additional water supplies for treatment and use.




## Attachment A

Brinker WSC
Alternative Strategy
Drill New Wells (Hopkins, Carrizo-Wilcox, Sulphur)

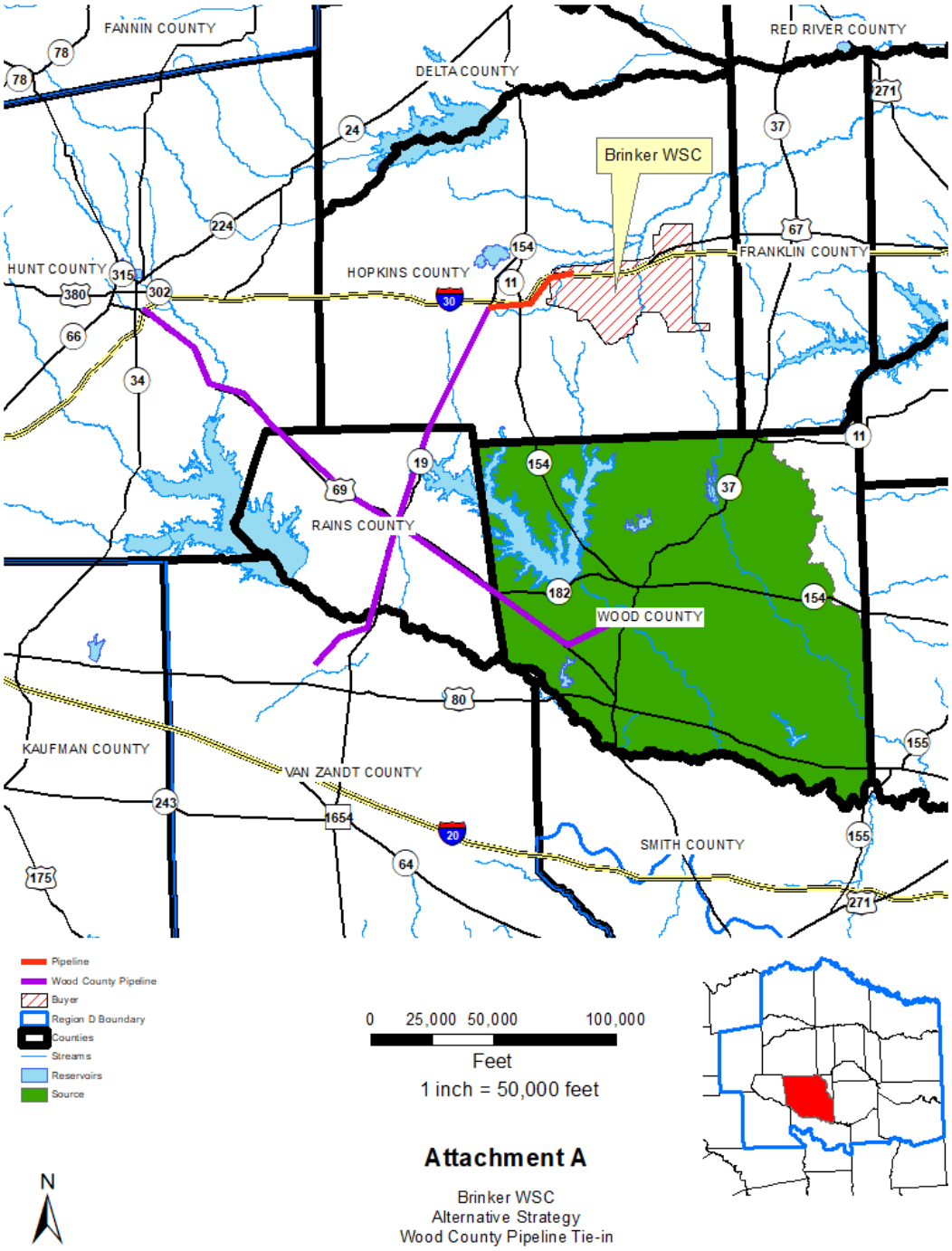
***Cost Estimate Summary***
***Water Supply Project Option***
***September 2018 Prices***

***Brinker WSC - Drill New Wells (Hopkins, Carrizo-Wilcox Aquifer, Sulphur Basin)***

***Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018***

| *Item* | *Estimated Costs for Facilities* |
|---|---|
| Well Fields (Wells, Pumps, and Piping) | $946,000 |
| Water Treatment Plant (0.2 MGD) | $32,000 |
| **TOTAL COST OF FACILITIES** | **$978,000** |
| | |
| Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities) | $342,000 |
| Environmental & Archaeology Studies and Mitigation | $35,000 |
| Land Acquisition and Surveying (4 acres) | $12,000 |
| Interest During Construction (3% for 1 years with a 0.5% ROI) | $38,000 |
| **TOTAL COST OF PROJECT** | **$1,405,000** |
| | |
| **ANNUAL COST** | |
| Debt Service (3.5 percent, 20 years) | $99,000 |
| Operation and Maintenance | |
| Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities) | $9,000 |
| Intakes and Pump Stations (2.5% of Cost of Facilities) | $0 |
| Dam and Reservoir (1.5% of Cost of Facilities) | $0 |
| Water Treatment Plant | $19,000 |
| Advanced Water Treamtent Facility | $0 |
| Pumping Energy Costs (69326 kW-hr @ 0.08 $/kW-hr) | $6,000 |
| Purchase of Water (83 acft/yr @ 500 $/acft) | $42,000 |
| **TOTAL ANNUAL COST** | **$175,000** |
| | |
| **Available Project Yield (acft/yr)** | 83 |
| **Annual Cost of Water ($ per acft), based on PF=1** | $2,108 |
| **Annual Cost of Water After Debt Service ($ per acft), based on PF=1** | $916 |
| **Annual Cost of Water ($ per 1,000 gallons), based on PF=1** | $6.47 |
| **Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1** | $2.81 |

*JMP* *9/30/2019*




**Attachment A**

Brinker WSC
Alternative Strategy
Wood County Pipeline Tie-in

***Cost Estimate Summary***
***Water Supply Project Option***
***September 2018 Prices***

***Brinker WSC - Wood County Pipeline Tie-in***

***Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018***

| *Item* | *Estimated Costs for Facilities* |
|---|---|
| Primary Pump Station (0 MGD) | $801,000 |
| Transmission Pipeline (0 in dia., miles) | $1,577,000 |
| **TOTAL COST OF FACILITIES** | **$2,378,000** |
| | |
| Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities) | $753,000 |
| Environmental & Archaeology Studies and Mitigation | $213,000 |
| Land Acquisition and Surveying (23 acres) | $127,000 |
| Interest During Construction (3% for 1 years with a 0.5% ROI) | $96,000 |
| **TOTAL COST OF PROJECT** | **$3,567,000** |
| | |
| **ANNUAL COST** | |
| Debt Service (3.5 percent, 20 years) | $251,000 |
| Operation and Maintenance | |
| Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities) | $16,000 |
| Intakes and Pump Stations (2.5% of Cost of Facilities) | $20,000 |
| Dam and Reservoir (1.5% of Cost of Facilities) | $0 |
| Water Treatment Plant | $0 |
| Advanced Water Treamtent Facility | $0 |
| Pumping Energy Costs (20964 kW-hr @ 0.08 $/kW-hr) | $2,000 |
| Purchase of Water (83 acft/yr @ 1442 $/acft) | $120,000 |
| **TOTAL ANNUAL COST** | **$409,000** |
| | |
| **Available Project Yield (acft/yr)** | 83 |
| **Annual Cost of Water ($ per acft), based on PF=2** | $4,928 |
| **Annual Cost of Water After Debt Service ($ per acft), based on PF=2** | $1,904 |
| **Annual Cost of Water ($ per 1,000 gallons), based on PF=2** | $15.12 |
| **Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=2** | $5.84 |

*JMP* *10/6/2019*

**EVALUATION OF ALTERNATIVE WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF CITY OF CUMBY**

**Description of Water User Group:**

The City of Cumby provides water service in Hopkins County. It is projected that the users in the WUG will have a shortage in 2020. The WUG population is projected to be 1,044 by 2020 and increases to 1,755 by 2070. The City of Cumby utilizes groundwater from the Nacatoch aquifer through 4 wells with a combined production capacity of 223 gpm. The City of Cumby is projected to have a deficit of 13 ac-ft in 2020 and increasing to a deficit of 88 ac-ft by 2070.

**Water Supply and Demand Analysis:**

| | **2020** | **2030** | **2040** | **2050** | **2060** | **2070** |
|---|---|---|---|---|---|---|
| **Population** | 1,044 | 1,212 | 1,363 | 1,496 | 1,660 | 1,755 |
| **Projected Water Demand** | 133 | 149 | 164 | 178 | 197 | 208 |
| **Water Demand from other entities** | 0 | 0 | 0 | 0 | 0 | 0 |
| **Current Water Supply** | 120 | 120 | 120 | 120 | 120 | 120 |
| **Projected Supply Surplus (+) / Deficit (-)** | **-13** | **-29** | **-44** | **-58** | **-77** | **-88** |

| **Projected Supply Surplus (+) / Deficit (-) by Basin** | **2020** | **2030** | **2040** | **2050** | **2060** | **2070** |
|---|---|---|---|---|---|---|
| **Sabine** | -13 | -27 | -41 | -54 | -71 | -81 |
| **Sulphur** | 0 | -2 | -3 | -4 | -6 | -7 |
| **Total** | **-13** | **-29** | **-44** | **-58** | **-77** | **-88** |

**Evaluation of Potentially Feasible Water Management Strategies:**

There were five alternative strategies considered to meet the WSC's water supply shortages as summarized in the table below. Advanced conservation was not selected because the per capita use per day was less than the 140 gpcd threshold set by the water planning group. Reuse is not a feasible option because water supply is mainly used for public consumption. The system is not presently large enough to treat surface water in a cost-effective manner. Additional groundwater from the Nacatoch Aquifer has been considered as a potential water management strategy. A potential regionalization strategy considered is the Wood County Pipeline where in the city could construct an eleven (11) mile long 8-inch diameter waterline that ties into a branch of the Wood County Pipeline near Sulphur Springs .

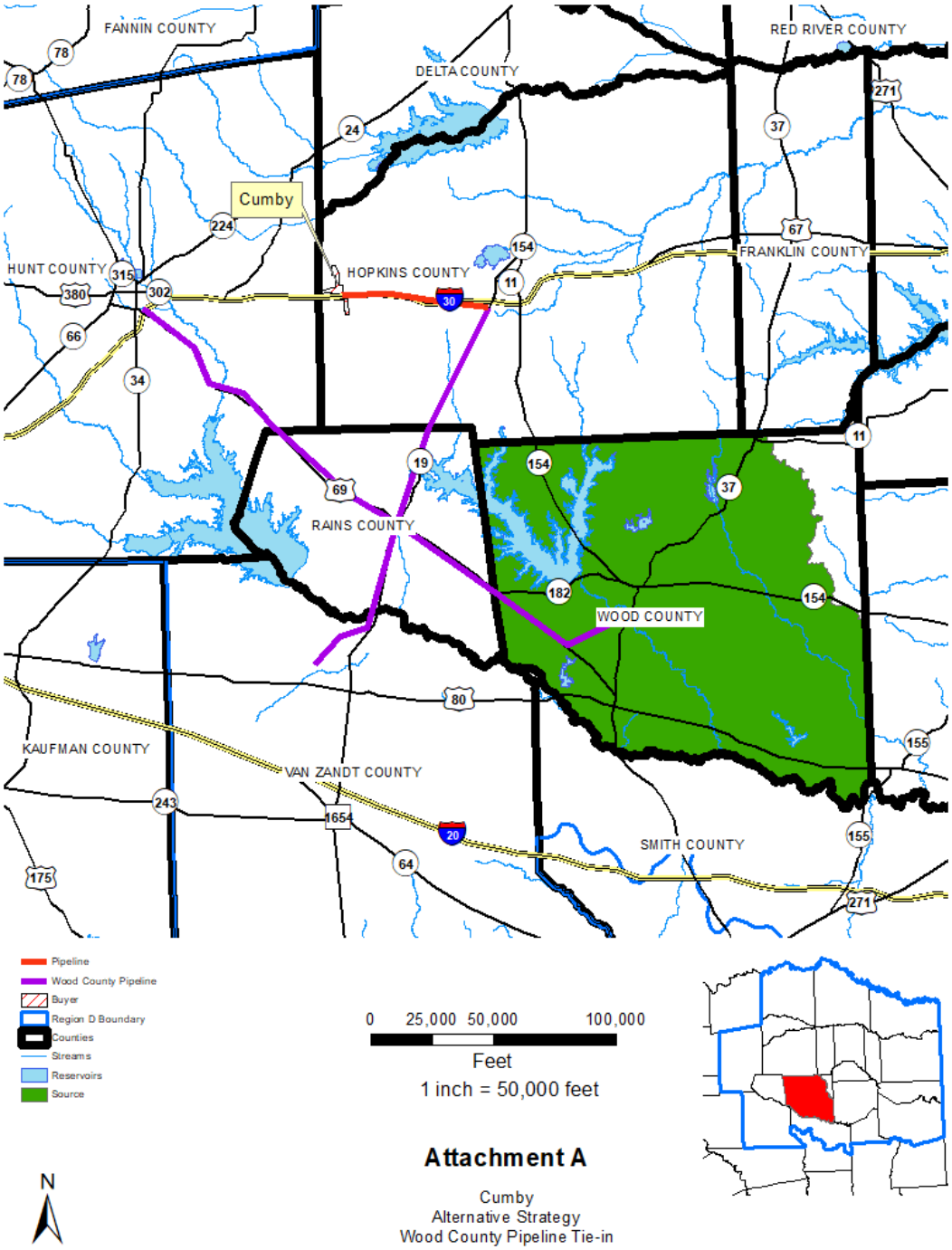
| **Strategy** | **Firm Yield (ac-ft)** | **Total Capital Cost** | **Total Annualized Cost** | **Unit Cost** | **Environmental Impact** |
|---|---|---|---|---|---|
| Advanced Water Conservation | | | | | |
| Water Reuse | | | | | |
| Drill New Wells (Nacatoch Aquifer, Sabine Basin, Hopkins County) | **88** | **$938,000** | **$142,000** | **$1,614** | **1** |
| Wood County Pipeline Tie-in | **88** | **$4,809,000** | **$511,000** | **$5,807** | **2** |

**Identified Alternative WMS and WMSP:**

| | **2020** | **2030** | **2040** | **2050** | **2060** | **2070** |
|---|---|---|---|---|---|---|
| **Wood County Pipeline Tie-in** | 13 | 29 | 44 | 58 | 77 | 88 |

The identified Alternative Water Management Strategy for the City of Cumby to meet their projected deficit of 13 ac-ft/yr in 2020 and 88 ac-ft/yr in 2070 is the Wood County Pipeline Strategy, of which an Alternative Water Management Strategy Project is for the City to construct an eleven (11) mile long 8-inch

diameter waterline that ties into a branch of the Wood County Pipeline near Sulphur Springs. This alternative strategy is contingent upon the development of a regionalized groundwater well field and conveyance pipeline in Wood County.



***Cost Estimate Summary***
***Water Supply Project Option***
***September 2018 Prices***

***Cumby - Wood County Pipeline Tie-in***

***Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018***

| *Item* | *Estimated Costs for Facilities* |
|---|---|
| Primary Pump Station (0 MGD) | $809,000 |
| Transmission Pipeline (0 in dia., miles) | $2,385,000 |
| **TOTAL COST OF FACILITIES** | **$3,194,000** |
| Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities) | $998,000 |
| Environmental & Archaeology Studies and Mitigation | $310,000 |
| Land Acquisition and Surveying (33 acres) | $178,000 |
| Interest During Construction (3% for 1 years with a 0.5% ROI) | $129,000 |
| **TOTAL COST OF PROJECT** | **$4,809,000** |
| **ANNUAL COST** | |
| Debt Service (3.5 percent, 20 years) | $338,000 |
| Operation and Maintenance | |
| Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities) | $24,000 |
| Intakes and Pump Stations (2.5% of Cost of Facilities) | $20,000 |
| Dam and Reservoir (1.5% of Cost of Facilities) | $0 |
| Water Treatment Plant | $0 |
| Advanced Water Treamtent Facility | $0 |
| Pumping Energy Costs (21889 kW-hr @ 0.08 $/kW-hr) | $2,000 |
| Purchase of Water (88 acft/yr @ $/acft) | $0 |
| **TOTAL ANNUAL COST** | **$384,000** |
| **Available Project Yield (acft/yr)** | 88 |
| **Annual Cost of Water ($ per acft), based on PF=2** | $4,364 |
| **Annual Cost of Water After Debt Service ($ per acft), based on PF=2** | $523 |
| **Annual Cost of Water ($ per 1,000 gallons), based on PF=2** | $13.39 |
| **Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=2** | $1.60 |

*JMP* *10/6/2019*

## EVALUATION OF ALTERNATIVE WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF IRRIGATION IN HOPKINS COUNTY

**Description of Water User Group:**

The Irrigation WUG in Hopkins County has a demand that is projected to remain constant at 4,769 ac-ft/yr for the planning period. The Irrigation WUG in Hopkins County is supplied by groundwater from the Carrizo-Wilcox Aquifer and run-of-river diversions from the Sabine and Sulphur Rivers. A deficit of 4,627 ac-ft/yr is projected to occur throughout the planning period.

**Water Supply and Demand Analysis:**

| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Projected Water Demand** | 4,769 | 4,769 | 4,769 | 4,769 | 4,769 | 4,769 |
| **Current Water Supply** | 144 | 144 | 144 | 144 | 144 | 144 |
| **Projected Supply Surplus (+)/Deficit(-)** | **-4,627** | **-4,627** | **-4,627** | **-4,627** | **-4,627** | **-4,627** |

| **Projected Supply Surplus (+)/Deficit(-) by Basin** | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Sabine** | 2 | 2 | 2 | 2 | 2 | 2 |
| **Sulphur** | -4,627 | -4,627 | -4,627 | -4,627 | -4,627 | -4,627 |
| **Cypress** | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total** | **-4,625** | **-4,625** | **-4,625** | **-4,625** | **-4,625** | **-4,625** |

**Evaluation of Potentially Feasible Water Management Strategies:**

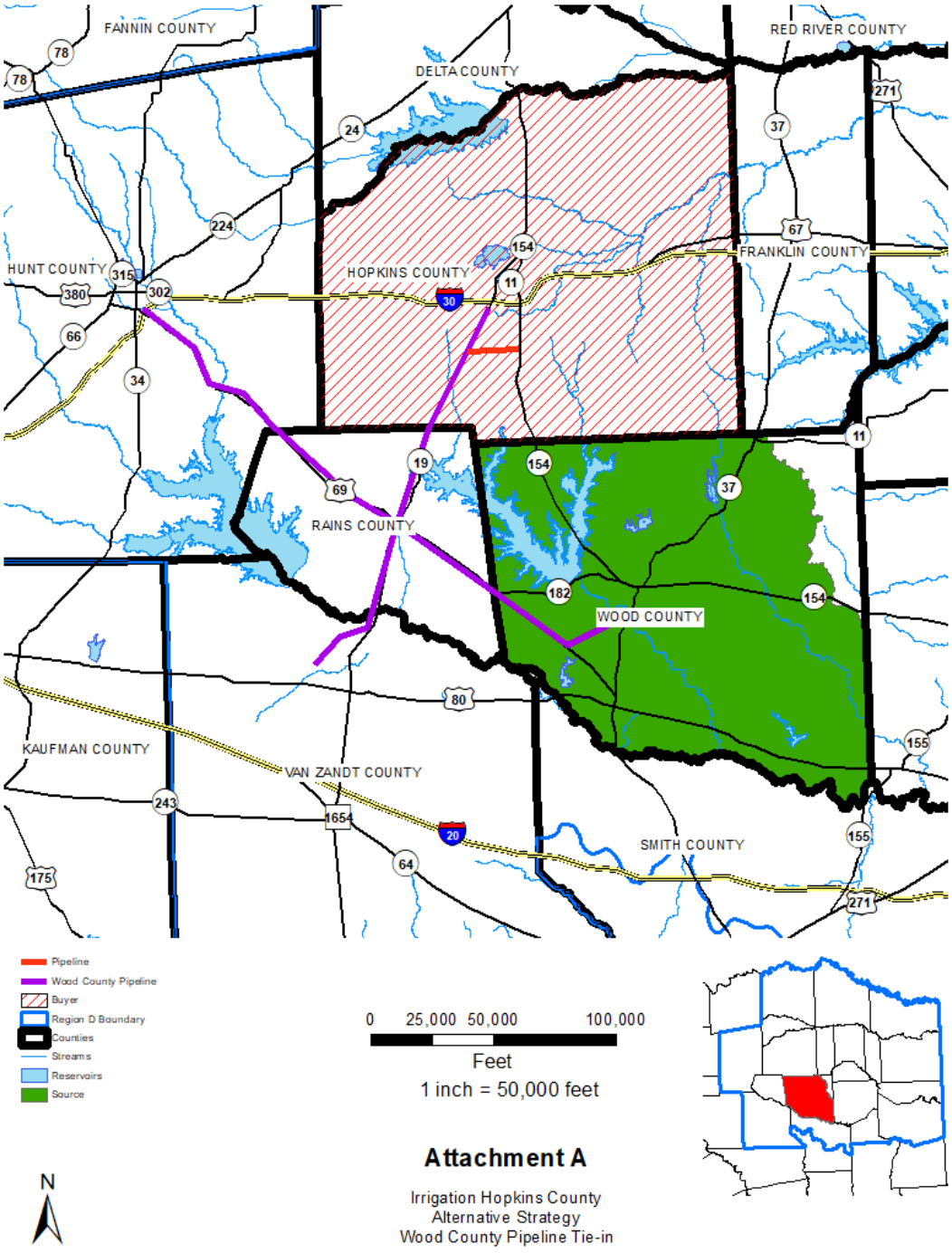
Three alternative strategies were considered to meet the projected shortages for Hopkins County Irrigation. Advanced water conservation for irrigation practices was not considered, as present irrigation practices likely already incorporate many BMPs to extend water supplies, thus no additional conservation would be feasible. The use of reuse water from nearby municipalities is not considered feasible as it would not be effective to deliver reuse water to the distributed farm irrigation systems. Groundwater from the Carrizo-Wilcox and Nacatoch aquifers has been identified as a potential source of water for irrigation in Hopkins County. The construction of a pipeline to convey raw surface water from Sulphur Springs Lake purchased via the City of Sulphur Springs was also considered as a potential alternative to meet projected demands. A potential regionalization strategy that was considered is the Wood County Pipeline which the WUG could tie-in to a branch of the Wood County Pipeline routed toward Sulphur Springs, Tx.

| Strategy | Strategy Yield (AF) | Total Capital Cost | Total Annualized Cost | Unit Cost | Environmental Impact |
|---|---|---|---|---|---|
| Advanced Water Conservation | | | | | |
| Water Reuse | | | | | |
| Drill New Wells (Carrizo-Wilcox, Cypress Basin) | | | | | |
| Drill New Wells (Carrizo-Wilcox, Sabine Basin) | **931** | **$2,814,000** | **$748,000** | **$803** | **1** |
| Drill New Wells (Carrizo-Wilcox, Sulphur Basin) | **4,627** | **$10,927,000** | **$3,511,000** | **$759** | **1** |
| Drill New Wells (Nacatoch, Sulphur Basin) | | | | | |
| Sulphur Springs Raw Water Pipeline | **4,627** | **$38,392,000** | **$9,039,000** | **$1,954** | **2** |
| Wood County Pipeline Tie-in | **4,627** | **$13,522,000** | **$7,181,000** | **$1,552** | **2** |

**Identified Alternative WMS and WMSP:**

| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Wood County Pipeline Tie-in** | **4,627** | **4,627** | **4,627** | **4,627** | **4,627** | **4,627** |

The identified Alternative Water Management Strategy for the Hopkins County Irrigation WUG to meet their projected deficit of 4,627 ac-ft/yr is the Wood County Pipeline Strategy, of which an Alternative Water Management Strategy Project is to construct a 24" diameter tie-in to the 30" transmission line of the Wood County Pipeline routed toward Sulphur Springs, Tx. This alternative strategy is contingent upon the regionalized development of a groundwater well field in Wood County and a conveyance pipeline from Wood County to Hopkins County.




## Attachment A

Irrigation Hopkins County
Alternative Strategy
Wood County Pipeline Tie-in

***Cost Estimate Summary***
***Water Supply Project Option***
***September 2018 Prices***

***Hopkins County Irrigation - Wood County Pipeline Tie-in***

***Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018***

| *Item* | *Estimated Costs for Facilities* |
|---|---|
| Primary Pump Station (0 MGD) | $3,577,000 |
| Transmission Pipeline (0 in dia., miles) | $6,146,000 |
| **TOTAL COST OF FACILITIES** | **$9,723,000** |
| | |
| Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities) | $3,096,000 |
| Environmental & Archaeology Studies and Mitigation | $214,000 |
| Land Acquisition and Surveying (23 acres) | $127,000 |
| Interest During Construction (3% for 1 years with a 0.5% ROI) | $362,000 |
| **TOTAL COST OF PROJECT** | **$13,522,000** |
| | |
| **ANNUAL COST** | |
| Debt Service (3.5 percent, 20 years) | $951,000 |
| Operation and Maintenance | |
| Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities) | $61,000 |
| Intakes and Pump Stations (2.5% of Cost of Facilities) | $89,000 |
| Dam and Reservoir (1.5% of Cost of Facilities) | $0 |
| Water Treatment Plant | $0 |
| Advanced Water Treatment Facility | $0 |
| Pumping Energy Costs (1336827 kW-hr @ 0.08 $/kW-hr) | $107,000 |
| Purchase of Water (4627 acft/yr @ 1291 $/acft) | $5,973,000 |
| **TOTAL ANNUAL COST** | **$7,181,000** |
| | |
| **Available Project Yield (acft/yr)** | 4,627 |
| **Annual Cost of Water ($ per acft), based on PF=2** | $1,552 |
| **Annual Cost of Water After Debt Service ($ per acft), based on PF=2** | $1,346 |
| **Annual Cost of Water ($ per 1,000 gallons), based on PF=2** | $4.76 |
| **Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=2** | $4.13 |

*JMP* *10/6/2019*

## EVALUATION OF ALTERNATIVE WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF LIVESTOCK IN HOPKINS COUNTY

**Description of Water User Group:**

The Livestock WUG in Hopkins County has a demand that is projected to remain constant at 5,498 ac-ft/yr for the planning period. The Livestock WUG in Hopkins County is supplied by groundwater from the Carrizo-Wilcox and Nacatoch Aquifers, livestock local supplies from the Cypress, Sulphur, and Sabine basins and surface water purchased from Sulphur Springs. A deficit of 1,068 ac-ft/yr is projected to occur in 2020 increasing to 1,219 ac-ft/yr by 2070 in the Sulphur basin. In both the Cypress and Sabine basins a surplus of 424 ac-ft/yr is projected by 2020 increasing to 577 ac-ft/yr by 2070.

**Water Supply and Demand Analysis:**

| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Projected Water Demand** | 5,498 | 5,498 | 5,498 | 5,498 | 5,498 | 5,498 |
| **Current Water Supply** | 4,854 | 4,854 | 4,854 | 4,854 | 4,855 | 4,856 |
| **Projected Supply Surplus (+)/Deficit(-)** | **-644** | **-644** | **-644** | **-644** | **-643** | **-642** |

| **Projected Supply Surplus (+)/Deficit(-) by Basin** | **2020** | **2030** | **2040** | **2050** | **2060** | **2070** |
|---|---|---|---|---|---|---|
| **Sabine** | 366 | 387 | 433 | 436 | 486 | 508 |
| **Sulphur** | -1,068 | -1,090 | -1,140 | -1,143 | -1,196 | -1,219 |
| **Cypress** | 58 | 59 | 63 | 63 | 67 | 69 |
| **Total** | **-644** | **-644** | **-644** | **-644** | **-643** | **-642** |

**Evaluation of Potentially Feasible Water Management Strategies:**

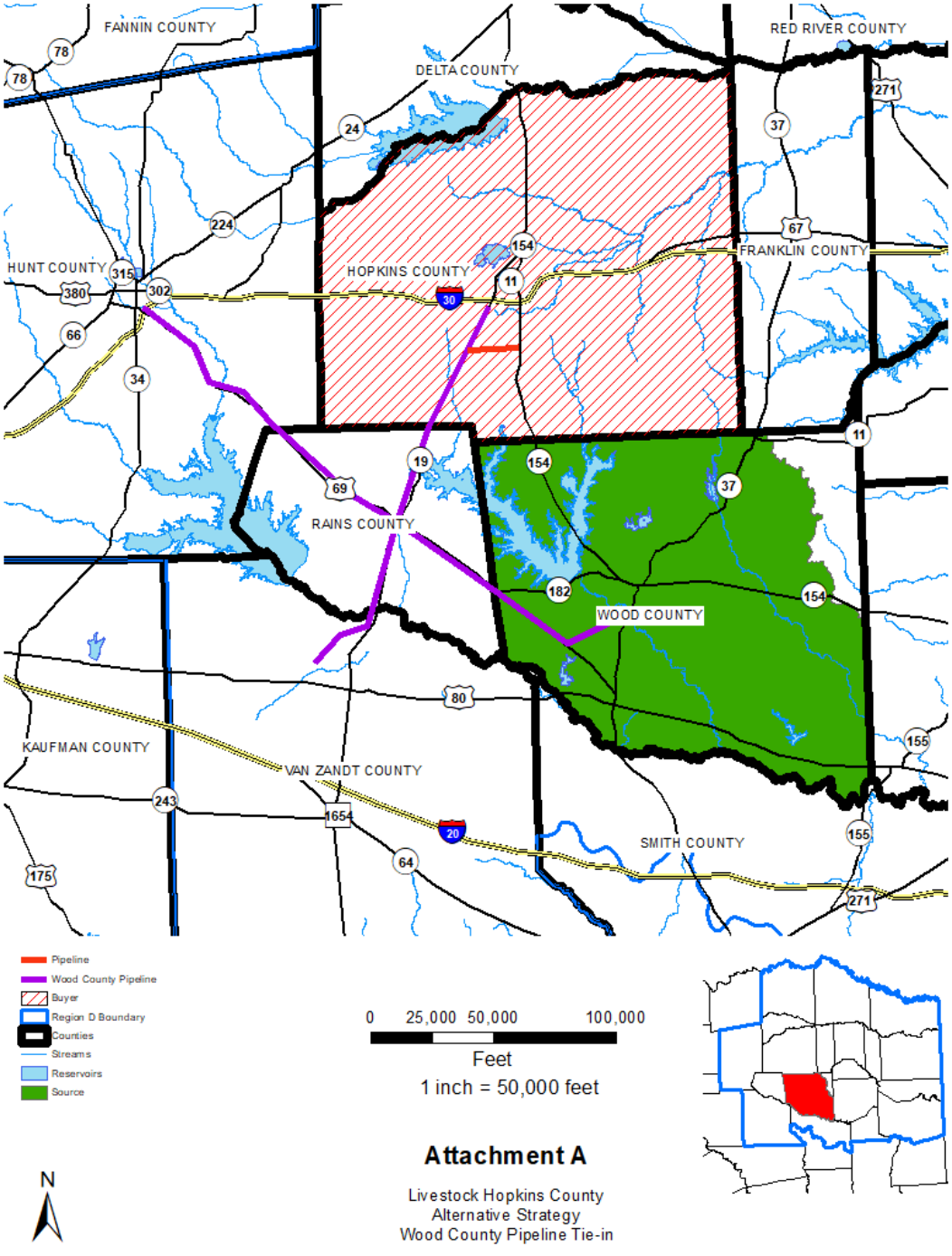
Eight alternative strategies were considered to meet the projected shortages for Hopkins County Livestock. Advanced water conservation for livestock practices was not considered, as present livestock practices likely result in sale of the livestock to reduce demand and extend water supply. The use of reuse water is not considered feasible as there is no centralized water supply. Groundwater from the Carrizo-Wilcox and Nacatoch aquifers has been identified as a potential source of water for irrigation in Hopkins County; however, the total needs exceed the availability of groundwater in the Nacatoch Aquifer based on the modeled available groundwater (MAG) estimates. Increasing the existing contract with the City of Sulphur Springs was also considered as a potential alternative to meet projected demands. A potential regionalization strategy that was considered is the Wood County Pipeline which the WUG could tie-in to a branch of the Wood County Pipeline routed toward Sulphur Springs, Tx.

| Strategy | Strategy Yield (AF) | Total Capital Cost | Total Annualized Cost | Unit Cost | Environmental Impact |
|---|---|---|---|---|---|
| Advanced Water Conservation | | | | | |
| Water Reuse | | | | | |
| Drill New Wells (Carrizo-Wilcox, Cypress Basin) | | | | | |
| Drill New Wells (Carrizo-Wilcox, Sabine Basin) | | | | | |
| Drill New Wells (Carrizo-Wilcox, Sulphur Basin) | **1,219** | **$6,373,000** | **$1,198,000** | **$983** | **1** |
| Drill New Wells (Nacatoch, Sulphur Basin) | | | | | |
| Increase Contract w/ Sulphur Springs | **1,219** | **$0** | **$1,434,000** | **$1,176** | **1** |
| Wood County Pipeline Tie-in | **1,219** | **$8,273,000** | **$2,464,000** | **$2,021** | **2** |

**Identified Alternative WMS and WMSP:**

| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Wood County Pipeline Tie-in** | **1,068** | **1,090** | **1,140** | **1,143** | **1,196** | **1,219** |

The identified Alternative Water Management Strategy for the Hopkins County Livestock WUG to meet their projected deficit of 1,219 ac-ft/yr is the Wood County Pipeline Strategy, of which an Alternative Water Management Strategy Project is to construct a 12" diameter tie-in pipeline to the 30" transmission line of the Wood County Pipeline routed toward the City of Sulphur Springs. This alternative strategy is contingent upon the regionalized development of a groundwater well field in Wood County and a conveyance pipeline from Wood County to Hopkins County.



***Cost Estimate Summary***
***Water Supply Project Option***
***September 2018 Prices***

***Hopkins County Livestock - Wood County Pipeline Tie-in***

***Cost based on ENR CCI 11170.28 for September 2018 and***
***a PPI of 201.9 for September 2018***

| *Item* | *Estimated Costs for Facilities* |
|---|---|
| Primary Pump Station (0 MGD) | $1,067,000 |
| Transmission Pipeline (0 in dia., miles) | $2,725,000 |
| Transmission Pump Station(s) & Storage Tank(s) | $2,020,000 |
| **TOTAL COST OF FACILITIES** | **$5,812,000** |
| Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities) | $1,898,000 |
| Environmental & Archaeology Studies and Mitigation | $214,000 |
| Land Acquisition and Surveying (23 acres) | $127,000 |
| Interest During Construction (3% for 1 years with a 0.5% ROI) | $222,000 |
| **TOTAL COST OF PROJECT** | **$8,273,000** |
| **ANNUAL COST** | |
| Debt Service (3.5 percent, 20 years) | $582,000 |
| Operation and Maintenance | |
| Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities) | $37,000 |
| Intakes and Pump Stations (2.5% of Cost of Facilities) | $53,000 |
| Dam and Reservoir (1.5% of Cost of Facilities) | $0 |
| Water Treatment Plant | $0 |
| Advanced Water Treatment Facility | $0 |
| Pumping Energy Costs (426528 kW-hr @ 0.08 $/kW-hr) | $34,000 |
| Purchase of Water (1219 acft/yr @ 1442 $/acft) | $1,758,000 |
| **TOTAL ANNUAL COST** | **$2,464,000** |
| **Available Project Yield (acft/yr)** | 1,219 |
| **Annual Cost of Water ($ per acft), based on PF=2** | $2,021 |
| **Annual Cost of Water After Debt Service ($ per acft), based on PF=2** | $1,544 |
| **Annual Cost of Water ($ per 1,000 gallons), based on PF=2** | $6.20 |
| **Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=2** | $4.74 |

*JMP* *10/6/2019*

**EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF MARTIN SPRINGS WATER SUPPLY CORPORATION**

**Description of Water User Group:**

Martin Springs WSC provides water service in Hopkins County. It is projected that the users in the WUG will have a shortage in 2070. The WUG population is projected to be 3,502 by 2020 and increases to 6,214 by 2070. Martin Springs WSC utilizes groundwater from the Carrizo-Wilcox aquifer and has a contract with the City of Sulphur Springs for surface water supply from Lake Chapman. Martin Springs WSC is projected to have a deficit of 29 ac-ft in 2070.

**Water Supply and Demand Analysis:**

| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Population** | 3,502 | 4,097 | 4,641 | 5,130 | 5,715 | 6,214 |
| **Projected Water Demand** | 424 | 478 | 529 | 578 | 642 | 698 |
| **Water Demand from other entities** | 0 | 0 | 0 | 0 | 0 | 0 |
| **Current Water Supply** | 668 | 667 | 666 | 668 | 669 | 669 |
| **Projected Supply Surplus (+) / Deficit (-)** | **244** | **189** | **137** | **90** | **27** | **-29** |

| **Projected Supply Surplus (+) / Deficit (-) by Basin** | **2020** | **2030** | **2040** | **2050** | **2060** | **2070** |
|---|---|---|---|---|---|---|
| **Sabine** | 204 | 158 | 113 | 75 | 22 | -27 |
| **Sulphur** | 40 | 31 | 24 | 15 | 5 | -2 |
| **Total** | **244** | **189** | **137** | **90** | **27** | **-29** |

**Evaluation of Potentially Feasible Water Management Strategies:**

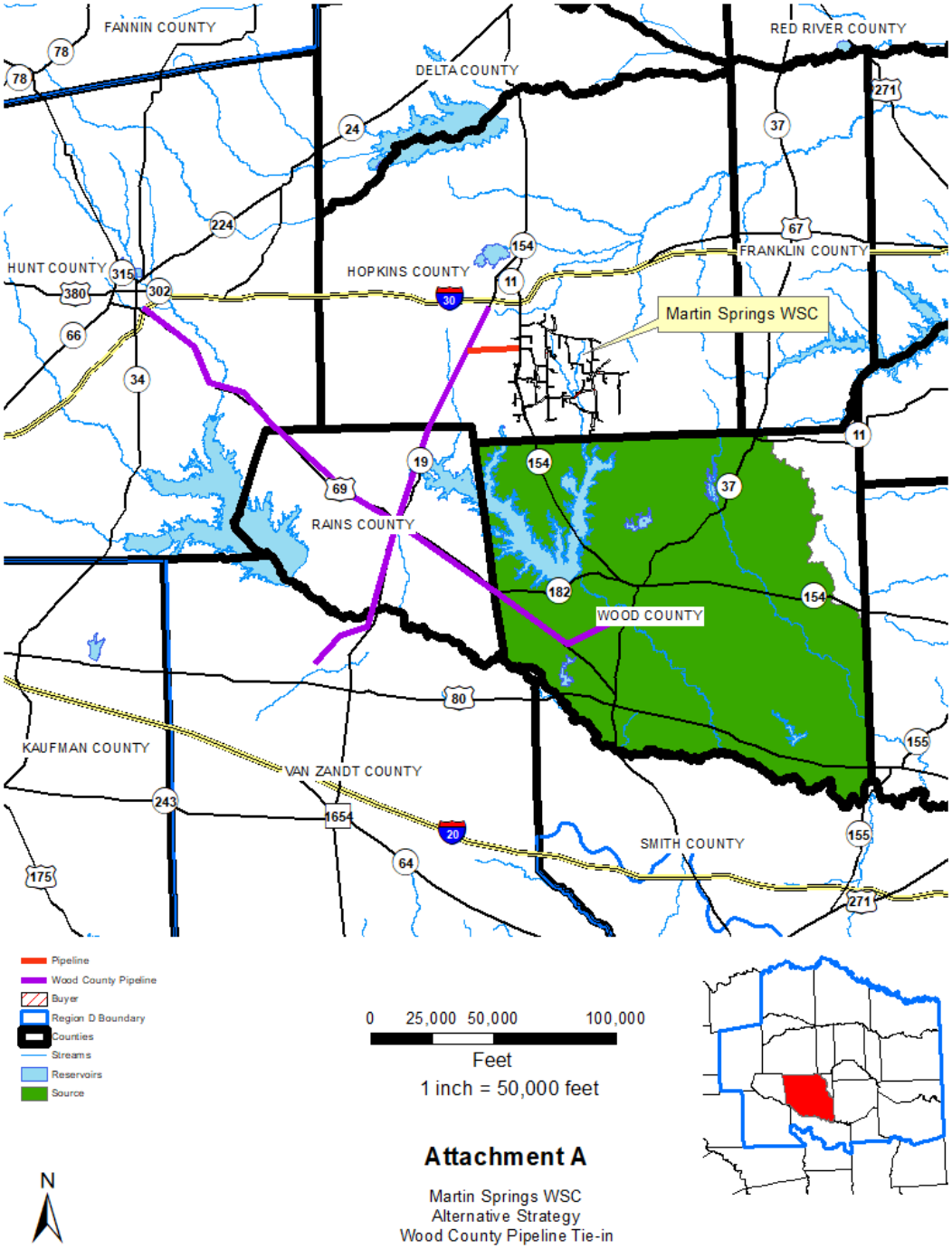
Six alternative strategies were considered to meet the WSC's water supply shortages as summarized in the table below. Advanced conservation was not selected because the per capita use per day was less than the 140 gpcd threshold set by the water planning group. Reuse is not a feasible option because water supply is mainly used for public consumption. Additional use of groundwater has been identified as a potential source of water for Martin Springs WSC in Hopkins County. A potential regionalization strategy that was considered is the Wood County Pipeline. Increasing the existing contract with Sulphur Springs was identified and considered as a potentially feasible strategy.

| Strategy | Firm Yield (ac-ft) | Total Capital Cost | Total Annualized Cost | Unit Cost | Env. Impact |
|---|---|---|---|---|---|
| Advanced Water Conservation | | | | | |
| Water Reuse | | | | | |
| Drill New Wells (Carrizo-Wilcox Aquifer, Sabine Basin) | | | | | |
| Drill New Wells (Carrizo-Wilcox Aquifer, Sulphur Basin) | **29** | **$360,000** | **$55,000** | **$1,897** | **1** |
| Increase Existing Contract w/ Sulphur Springs | **29** | **$0** | **$34,000** | **$1,172** | **1** |
| Wood County Pipeline Tie-in | **29** | **$1,574,000** | **$166,000** | **$5,724** | **2** |

**Identified Alternative WMS and WMSP:**

| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Wood County Pipeline Tie-in** | **0** | **0** | **0** | **0** | **0** | **29** |

The identified Alternative Water Management Strategy for Martin Springs WSC to meet their projected deficit of 29 ac-ft/yr by 2070 is the Wood County Pipeline Strategy, of which an Alternative Water Management Strategy Project is to construct an 8" tie-in pipeline to the the Hopkins County branch of the Wood County Pipeline. This alternative strategy is contingent upon the regionalized development of a groundwater well field in Wood County and a conveyance pipeline from Wood County to Hopkins County.




**Attachment A**

Martin Springs WSC
Alternative Strategy
Wood County Pipeline Tie-in

***Cost Estimate Summary***
***Water Supply Project Option***
***September 2018 Prices***

***Martin Springs WSC - Wood County Pipeline***

***Cost based on ENR CCI 11170.28 for September 2018 and***
***a PPI of 201.9 for September 2018***

| *Item* | *Estimated Costs for Facilities* |
|---|---|
| Primary Pump Station (0 MGD) | $182,000 |
| Transmission Pipeline (0 in dia., miles) | $832,000 |
| **TOTAL COST OF FACILITIES** | **$1,014,000** |
| | |
| Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities) | $313,000 |
| Environmental & Archaeology Studies and Mitigation | $124,000 |
| Land Acquisition and Surveying (15 acres) | $80,000 |
| Interest During Construction (3% for 1 years with a 0.5% ROI) | $43,000 |
| **TOTAL COST OF PROJECT** | **$1,574,000** |
| | |
| **ANNUAL COST** | |
| Debt Service (3.5 percent, 20 years) | $111,000 |
| Operation and Maintenance | |
| Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities) | $8,000 |
| Intakes and Pump Stations (2.5% of Cost of Facilities) | $5,000 |
| Dam and Reservoir (1.5% of Cost of Facilities) | $0 |
| Water Treatment Plant | $0 |
| Advanced Water Treatment Facility | $0 |
| Pumping Energy Costs (2949 kW-hr @ 0.08 $/kW-hr) | $0 |
| Purchase of Water (29 acft/yr @ 1442 $/acft) | $42,000 |
| **TOTAL ANNUAL COST** | **$166,000** |
| | |
| **Available Project Yield (acft/yr)** | 29 |
| **Annual Cost of Water ($ per acft), based on PF=2** | $5,724 |
| **Annual Cost of Water After Debt Service ($ per acft), based on PF=2** | $1,897 |
| **Annual Cost of Water ($ per 1,000 gallons), based on PF=2** | $17.56 |
| **Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=2** | $5.82 |

*JMP* *10/6/2019*

## EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF MILLER GROVE WATER SUPPLY CORPORATION

**Description of Water User Group:**

Miller Grove WSC provides water service in Hopkins County. It is projected that the users in the WUG will have a shortage in 2020. The WUG population is projected to be 1,451 by 2020 and increases to 1,896 by 2070. Miller Grove WSC utilizes groundwater from the Carrizo-Wilcox aquifer. Miller Grove WSC is projected to have a deficit of 8 ac-ft by 2020 increasing to 52 ac-ft by 2070.

**Water Supply and Demand Analysis:**

| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Population** | 1,451 | 1,559 | 1,649 | 1,706 | 1,802 | 1,896 |
| **Projected Water Demand** | 200 | 208 | 215 | 221 | 232 | 244 |
| **Water Demand from other entities** | 0 | 0 | 0 | 0 | 0 | 0 |
| **Current Water Supply** | 192 | 192 | 192 | 192 | 192 | 192 |
| **Projected Supply Surplus (+) / Deficit (-)** | **-8** | **-16** | **-23** | **-29** | **-40** | **-52** |

**Evaluation of Potentially Feasible Water Management Strategies:**

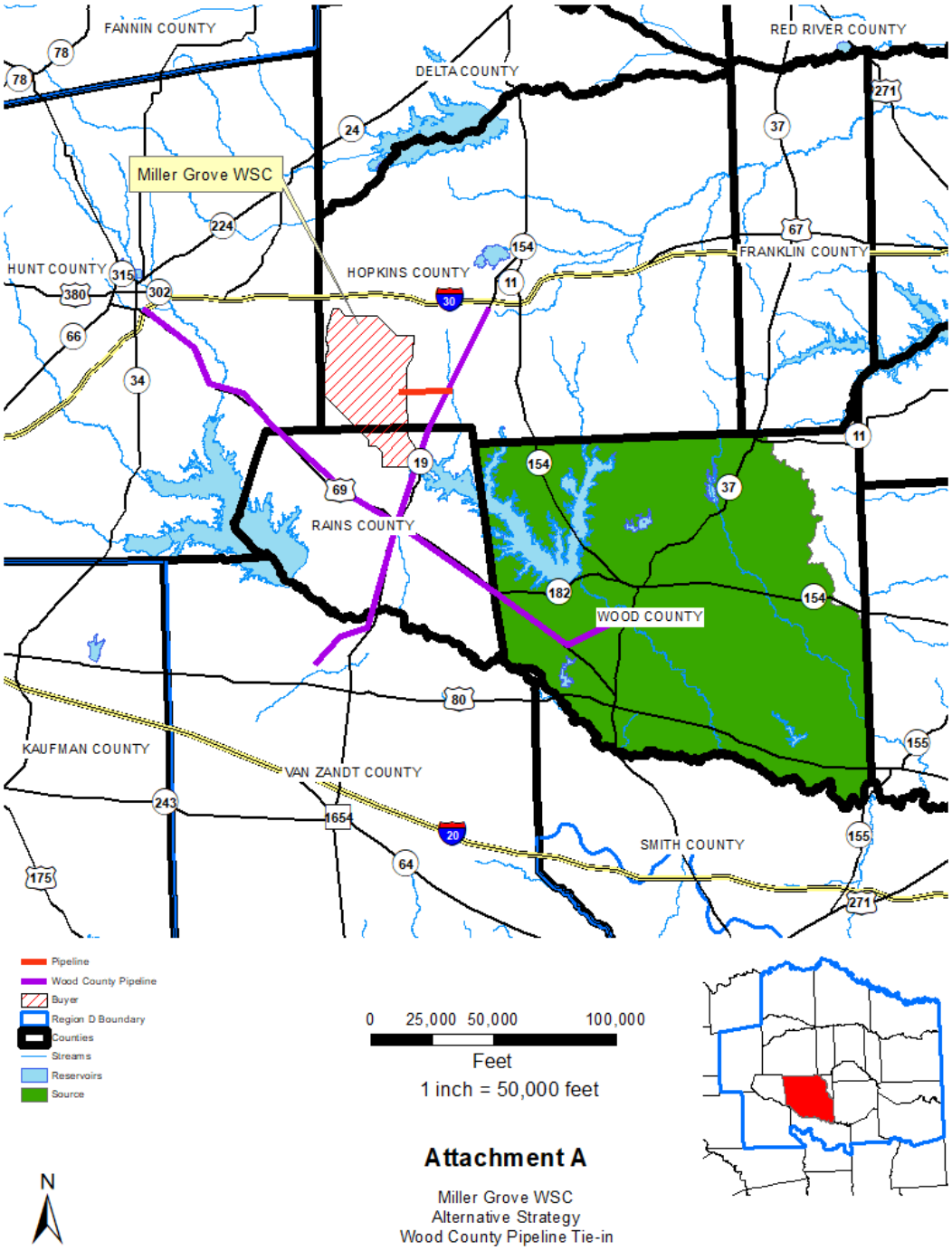
Five alternative strategies were considered to meet the WSC's water supply shortages as summarized in the table below. Advanced conservation was not selected because the per capita use per day was less than the 140 gpcd threshold set by the water planning group. Reuse is not a feasible option because water supply is mainly used for public consumption. Additional use of groundwater has been identified as a potential source of water the WSC. Purchase of surface water from Chapman Lake under contract from Sulphur Springs was also considered. A potential regionalization strategy that was considered is the Wood County Pipeline.

| Strategy | Firm Yield (ac-ft) | Total Capital Cost | Total Annualized Cost | Unit Cost | Env. Impact |
|---|---|---|---|---|---|
| Advanced Water Conservation | | | | | |
| Water Reuse | | | | | |
| Drill New Wells (Carrizo-Wilcox Aquifer, Sulphur Basin) | **52** | **$886,000** | **$113,000** | **$2,173** | **1** |
| New Contract (Chapman, Sulphur Springs) | **52** | **$2,319,000** | **$242,000** | **$4,654** | **1** |
| Wood County Pipeline Tie-in | **52** | **$1,587,000** | **$200,000** | **$3,846** | **2** |

**Identified Alternative WMS and WMSP:**

| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Wood County Pipeline Tie-in** | **8** | **16** | **23** | **29** | **40** | **52** |

The identified Alternative Water Management Strategy for Miller Grove WSC to meet their projected deficit of 8 ac-ft/yr in 2020 and 52 ac-ft/yr in 2070 is the Wood County Pipeline Strategy, of which an Alternative Water Management Strategy Project is to construct an 8" raw water pipeline to tie into the Hopkins County Branch of the Wood County Pipeline. This alternative strategy is contingent upon the regionalized development of a groundwater well field in Wood County and a conveyance pipeline from Wood County to Hopkins County.




**Attachment A**

Miller Grove WSC
Alternative Strategy
Wood County Pipeline Tie-in

***Cost Estimate Summary***
***Water Supply Project Option***
***September 2018 Prices***

***Miller Grove WSC - Wood County Pipeline***

***Cost based on ENR CCI 11170.28 for September 2018 and***
***a PPI of 201.9 for September 2018***

| *Item* | *Estimated Costs for Facilities* |
|---|---|
| Primary Pump Station (0 MGD) | $159,000 |
| Transmission Pipeline (0 in dia., miles) | $861,000 |
| **TOTAL COST OF FACILITIES** | **$1,020,000** |
| | |
| Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities) | $314,000 |
| Environmental & Archaeology Studies and Mitigation | $128,000 |
| Land Acquisition and Surveying (15 acres) | $82,000 |
| Interest During Construction (3% for 1 years with a 0.5% ROI) | $43,000 |
| **TOTAL COST OF PROJECT** | **$1,587,000** |
| | |
| **ANNUAL COST** | |
| Debt Service (3.5 percent, 20 years) | $112,000 |
| Operation and Maintenance | |
| Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities) | $9,000 |
| Intakes and Pump Stations (2.5% of Cost of Facilities) | $4,000 |
| Dam and Reservoir (1.5% of Cost of Facilities) | $0 |
| Water Treatment Plant | $0 |
| Advanced Water Treatment Facility | $0 |
| Pumping Energy Costs (2288 kW-hr @ 0.08 $/kW-hr) | $0 |
| Purchase of Water (52 acft/yr @ 1442 $/acft) | $75,000 |
| **TOTAL ANNUAL COST** | **$200,000** |
| | |
| **Available Project Yield (acft/yr)** | 52 |
| **Annual Cost of Water ($ per acft), based on PF=2** | $3,846 |
| **Annual Cost of Water After Debt Service ($ per acft), based on PF=2** | $1,692 |
| **Annual Cost of Water ($ per 1,000 gallons), based on PF=2** | $11.80 |
| **Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=2** | $5.19 |

*JMP* *10/6/2019*

## EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF MINING IN HOPKINS COUNTY

**Description of Water User Group:**

Mining in Hopkins County has a demand that is projected to increase from 1,031 ac-ft/yr in 2020 to 1,577 ac-ft/yr in 2070. This WUG is projected to be supplied by groundwater from Nacatoch Aquifer and a nominal amount of surface water purchased from Sulphur Springs for potable use. A deficit of 227 ac-ft/yr is projected to occur in 2020 and increase to 639 ac-ft/yr by 2070.

**Water Supply and Demand Analysis:**

| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Projected Water Demand** | 1,031 | 1,124 | 1,222 | 1,329 | 1,446 | 1,577 |
| **Current Water Supply** | 804 | 841 | 862 | 885 | 913 | 938 |
| **Projected Supply Surplus (+)/Deficit(-)** | **-227** | **-283** | **-360** | **-444** | **-533** | **-639** |

| **Projected Supply Surplus (+)/Deficit(-) by Basin** | **2020** | **2030** | **2040** | **2050** | **2060** | **2070** |
|---|---|---|---|---|---|---|
| **Sulphur** | -149 | -186 | -236 | -293 | -352 | -422 |
| **Sabine** | -71 | -89 | -112 | -138 | -166 | -198 |
| **Cypress** | -7 | -8 | -12 | -13 | -15 | -19 |
| **Total** | **-227** | **-283** | **-360** | **-444** | **-533** | **-639** |

**Evaluation of Potentially Feasible Water Management Strategies:**

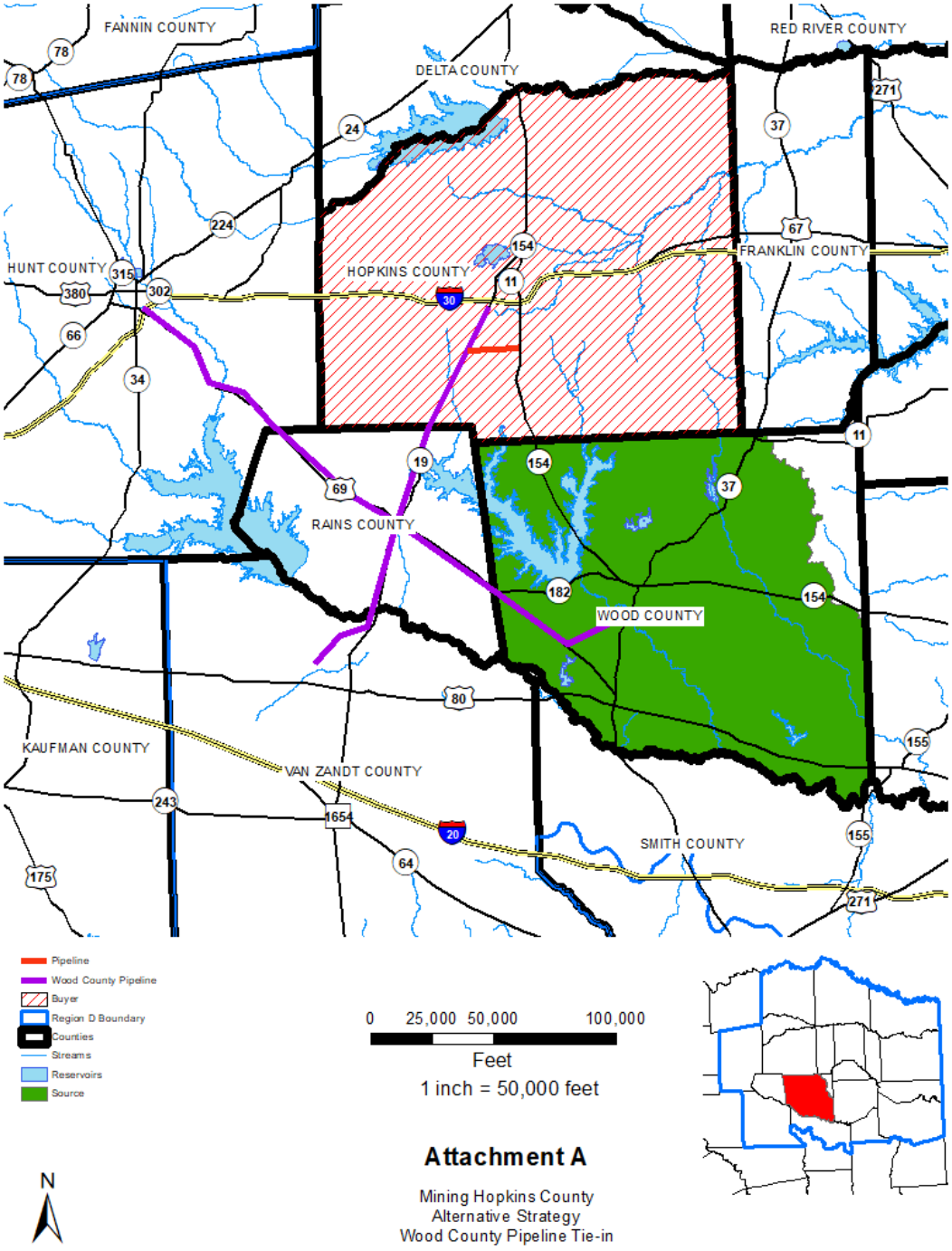
Advanced water conservation for mining practices was not considered, as present operations of the facilities are not available. The use of reuse water from nearby municipalities was not considered feasible as it would not be effective to deliver reuse water to the mining locations. Since the projected demands for mining in Hopkins County are primarily due to overburden dewatering, it was assumed that projected needs would likely be met by additional groundwater pumping. Increasing the existing contract from Sulphur Springs could provide additional supply. Additionally, the Wood County Pipeline regional strategy was evaluated as a feasible supply source.

| Strategy | Firm Yield (ac-ft) | Total Capital Cost | Total Annualized Cost | Unit Cost | Env. Impact |
|---|---|---|---|---|---|
| Advanced Water Conservation | | | | | |
| Water Reuse | | | | | |
| Drill New Wells (Nacatoch Aquifer, Sulphur Basin) | | | | | |
| Drill New Wells (Carrizo-Wilcox Aquifer, Sulphur Basin) | 639 | $3,376,000 | $628,000 | $983 | 1 |
| Increase Existing Contract from Sulphur Springs | 639 | $0 | $751,000 | $1,175 | 1 |
| Wood County Pipeline Tie-in | 639 | $5,367,000 | $1,365,000 | $2,136 | 2 |

**Identified Alternative WMS and WMSP:**

| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Wood County Pipeline Tie-in** | **227** | **283** | **360** | **444** | **533** | **639** |

The identified Alternative Water Management Strategy for the Hopkins County Mining to meet their projected deficit of up to 639 ac-ft/yr is the Wood County Pipeline Strategy, of which an Alternative Water Management Strategy Project is to construct a 12" raw water line to tie into the Hopkins County Branch of the Wood County Pipeline. This alternative strategy is contingent upon the regionalized development of a groundwater well field in Wood County and a conveyance pipeline from Wood County to Hopkins County.



***Cost Estimate Summary***
***Water Supply Project Option***
***September 2018 Prices***

***Hopkins County Mining - Wood County Pipeline Tie-in***

***Cost based on ENR CCI 11170.28 for September 2018 and***
***a PPI of 201.9 for September 2018***

| *Item* | *Estimated Costs for Facilities* |
|---|---|
| Primary Pump Station (0 MGD) | $992,000 |
| Transmission Pipeline (0 in dia., miles) | $2,725,000 |
| **TOTAL COST OF FACILITIES** | **$3,717,000** |
| | |
| Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities) | $1,165,000 |
| Environmental & Archaeology Studies and Mitigation | $214,000 |
| Land Acquisition and Surveying (23 acres) | $127,000 |
| Interest During Construction (3% for 1 years with a 0.5% ROI) | $144,000 |
| **TOTAL COST OF PROJECT** | **$5,367,000** |
| | |
| **ANNUAL COST** | |
| Debt Service (3.5 percent, 20 years) | $378,000 |
| Operation and Maintenance | |
| Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities) | $27,000 |
| Intakes and Pump Stations (2.5% of Cost of Facilities) | $25,000 |
| Dam and Reservoir (1.5% of Cost of Facilities) | $0 |
| Water Treatment Plant | $0 |
| Advanced Water Treamtent Facility | $0 |
| Pumping Energy Costs (177940 kW-hr @ 0.08 $/kW-hr) | $14,000 |
| Purchase of Water (639 acft/yr @ 1442 $/acft) | $921,000 |
| **TOTAL ANNUAL COST** | **$1,365,000** |
| | |
| **Available Project Yield (acft/yr)** | 639 |
| **Annual Cost of Water ($ per acft), based on PF=2** | $2,136 |
| **Annual Cost of Water After Debt Service ($ per acft), based on PF=2** | $1,545 |
| **Annual Cost of Water ($ per 1,000 gallons), based on PF=2** | $6.55 |
| **Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=2** | $4.74 |

*JMP* *10/6/2019*

REGION D
EVALUATIONS OF ALTERNATIVE WATER MANAGEMENT STRATEGIES
FOR MEETING PROJECTED WATER SUPPLY NEEDS
TO YEAR 2070

# HUNT COUNTY

*WUGs:*

B H P WSC
Caddo Basin SUD
Caddo Mills
Cash SUD
The City of Celeste
Hunt County-Other
The City of Greenville
Hickory Creek SUD
Hunt County Mining
North Hunt SUD
Poetry WSC
The City of Wolfe City

## EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF B H P WATER SUPPLY CORPORATION IN HUNT COUNTY

**Description of Water User Group:**

B H P WSC provides water service in western Hunt County, southeastern Colin County and northeastern Rockwall County. The WUG population is projected to be 5,233 people in 2020 and 18,110 by the year 2070. The water supply for this WSC is treated surface water purchased from Royse City, the source of whose supplies derive from the NTMWD system (i.e., indirect reuse via Lake Lavon and the NTMWD reservoir system) and the Sabine River Authority's system (i.e., Lake Fork and Lake Tawakoni). The WSC is projected to have a deficit of 3 ac-ft/yr in 2020 increasing to a deficit of 505 ac-ft/yr by 2070.

**Water Supply and Demand Analysis:**

| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Population** | 5,233 | 6,647 | 8,426 | 10,583 | 13,664 | 18,110 |
| **Projected Water Demand** | 391 | 467 | 571 | 711 | 918 | 1,216 |
| **Water Demand from other entities** | 0 | 0 | 0 | 0 | 0 | 0 |
| **Current Water Supply** | 389 | 395 | 446 | 502 | 585 | 711 |
| **Projected Supply Surplus (+) / Deficit (-)** | **-2** | **-72** | **-125** | **-209** | **-333** | **-505** |

**Evaluation of Potentially Feasible Water Management Strategies:**

Multiple alternative strategies considered to meet B H P WSC's water supply shortages are listed in the table below. Advanced conservation was not selected because the per capita use per day was less than the 140 gpcd threshold set by the water planning group; however, coordination with the Region C Planning Group indicates that conservation is a potential strategy for that portion of the WSC within the Region C planning area, thus conservation amounts identified by the Region C Planning Group have been incorporated herein for this WUG. Reuse is not a feasible option because water supply is mainly used for public consumption. Potentially feasible strategies include increase of the existing contract with Royse City, or alternatively establishing a new water supply contract with North Texas Municipal Water District. Another potentially feasible strategy is the Wood County Pipeline which could supply groundwater from Wood County. Groundwater use from the portion of the Nacatoch Aquifer located in the Sabine River Basin in Hunt County was also evaluated as a potentially feasible strategy.

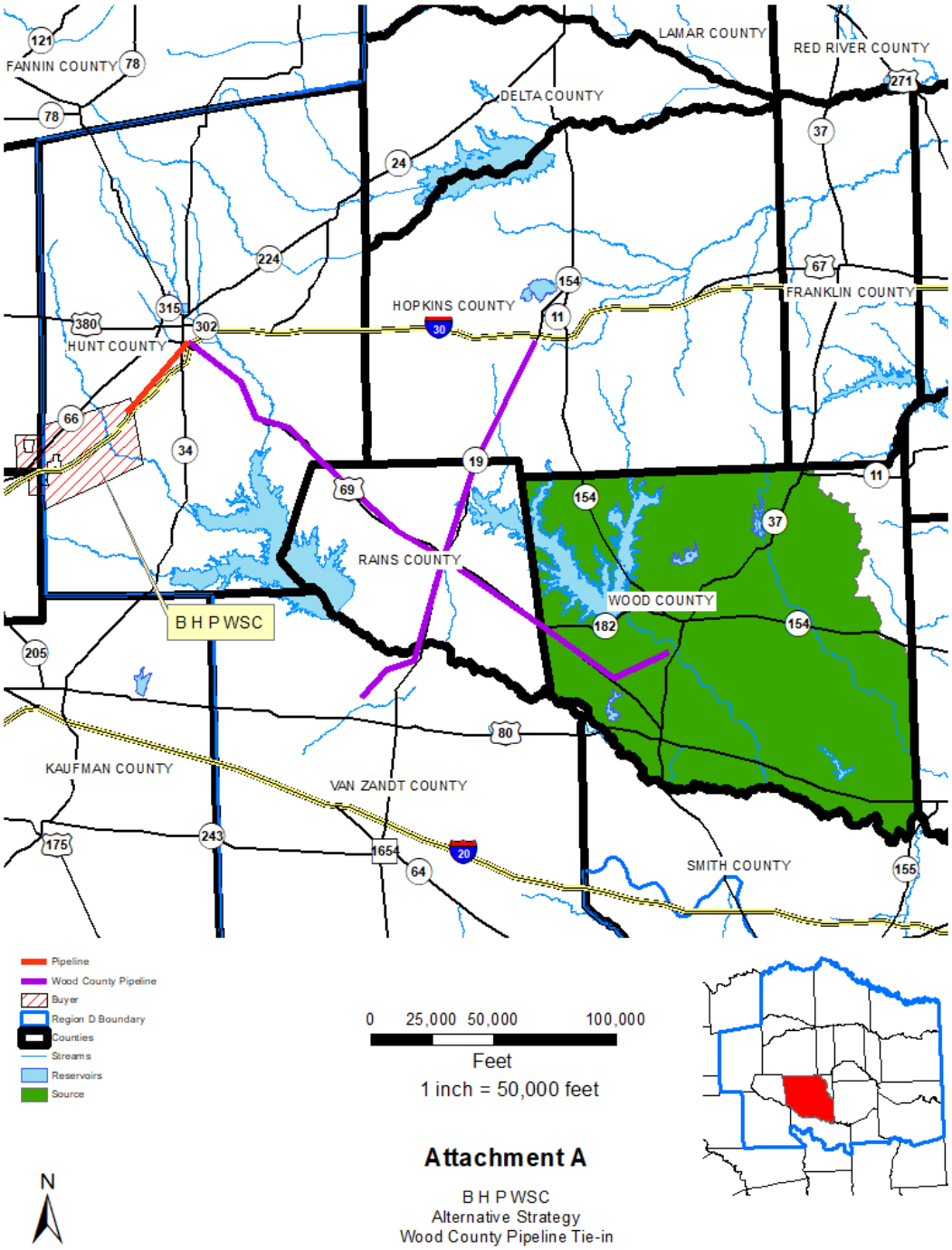
| Strategy | Firm Yield (ac-ft) | Total Capital Cost | Total Annual Cost | Unit Cost | Environmental Impact |
|---|---|---|---|---|---|
| Advanced Water Conservation | **3** | **$0** | **$0** | **$0** | **1** |
| Water Reuse | | | | | |
| Drill New Wells (Hunt, Nacatoch Aquifer, Sabine Basin) | **505** | **$1,689,000** | **$416,000** | **$824** | **1** |
| Increase Contract (Royse City) | **502** | **$0** | **$251,000** | **$500** | **1** |
| Wood County Pipeline Tie-in | **502** | **$1,086,000** | **$823,000** | **$1,639** | **2** |

**Identified Alternative WMS and WMSP:**

| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Wood County Pipeline Tie-in** | 2 | 72 | 125 | 209 | 333 | 505 |

The identified Alternative Water Management Strategy for BHP WSC is the Wood County Pipeline Strategy, of which an Alternative Water Management Strategy Project is to construct, in association with Caddo Basin SUD and Poetry WSC, a 14" raw water line to tie into the Hunt County Branch of the Wood County Pipeline proposed to end near the City of Greenville. Cost estimates presented herein represent to total capital cost of the pipeline, which would be proportionally shared with Caddo Basin SUD and Poetry WSC. The total annual

cost and unit cost represent the debt service of the project as well as annual operation costs for conveyance of up to 505 ac-ft per year. This alternative strategy is contingent upon the regionalized development of a groundwater well field in Wood County and a conveyance pipeline from Wood County to Hunt County.



***Cost Estimate Summary***
***Water Supply Project Option***
***September 2018 Prices***

***B H P WSC, Caddo Basin SUD, Poetry WSC - Wood County Pipeline Tie-in***

***Cost based on ENR CCI 11170.28 for September 2018 and***
***a PPI of 201.9 for September 2018***

| ***Item*** | ***Estimated Costs for Facilities*** |
|---|---|
| Primary Pump Station (0 MGD) | $1,176,000 |
| Transmission Pipeline (0 in dia., miles) | $3,184,000 |
| **TOTAL COST OF FACILITIES** | **$4,360,000** |
| | |
| Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities) | $1,367,000 |
| Environmental & Archaeology Studies and Mitigation | $208,000 |
| Land Acquisition and Surveying (23 acres) | $124,000 |
| Interest During Construction (3% for 1 years with a 0.5% ROI) | $167,000 |
| **TOTAL COST OF PROJECT** | **$6,226,000** |
| | |
| **ANNUAL COST** | |
| Debt Service (3.5 percent, 20 years) | $438,000 |
| Operation and Maintenance | |
| Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities) | $32,000 |
| Intakes and Pump Stations (2.5% of Cost of Facilities) | $29,000 |
| Dam and Reservoir (1.5% of Cost of Facilities) | $0 |
| Water Treatment Plant | $0 |
| Advanced Water Treamtent Facility | $0 |
| Pumping Energy Costs (867231 kW-hr @ 0.08 $/kW-hr) | $69,000 |
| Purchase of Water (2878 acft/yr @ 1442 $/acft) | $4,150,000 |
| **TOTAL ANNUAL COST** | **$4,718,000** |
| | |
| **Available Project Yield (acft/yr)** | 2,878 |
| **Annual Cost of Water ($ per acft), based on PF=1** | $1,639 |
| **Annual Cost of Water After Debt Service ($ per acft), based on PF=1** | $1,487 |
| **Annual Cost of Water ($ per 1,000 gallons), based on PF=1** | $5.03 |
| **Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1** | $4.56 |

*JMP* *10/6/2019*

**EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF CADDO BASIN SUD IN HUNT COUNTY**

**Description of Water User Group:**

Caddo Basin SUD provides water service in western Hunt County and eastern Collin County. The WUG population is projected to be 10,115 in 2020 and 43,698 by the year 2070. The SUD purchases treated water from North Texas MWD and Farmersville. The SUD is projected to have a shortage beginning in 2020 based on the availability of current firm supplies from North Texas MWD. The SUD is projected to have a deficit of 8 ac-ft in 2020 increasing to a deficit of 1,866 ac-ft by 2070.

**Water Supply and Demand Analysis:**

| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Population** | 10,115 | 13,263 | 17,792 | 23,883 | 32,195 | 43,698 |
| **Projected Water Demand** | 1,128 | 1,417 | 1,855 | 2,465 | 3,314 | 4,493 |
| **Water Demand from other entities** | 0 | 0 | 0 | 0 | 0 | 0 |
| **Current Water Supply** | 1,121 | 1,197 | 1,449 | 1,743 | 2,112 | 2,627 |
| **Projected Supply Surplus (+) / Deficit (-)** | **-7** | **-220** | **-406** | **-722** | **-1,202** | **-1,866** |

**Evaluation of Potentially Feasible Water Management Strategies:**

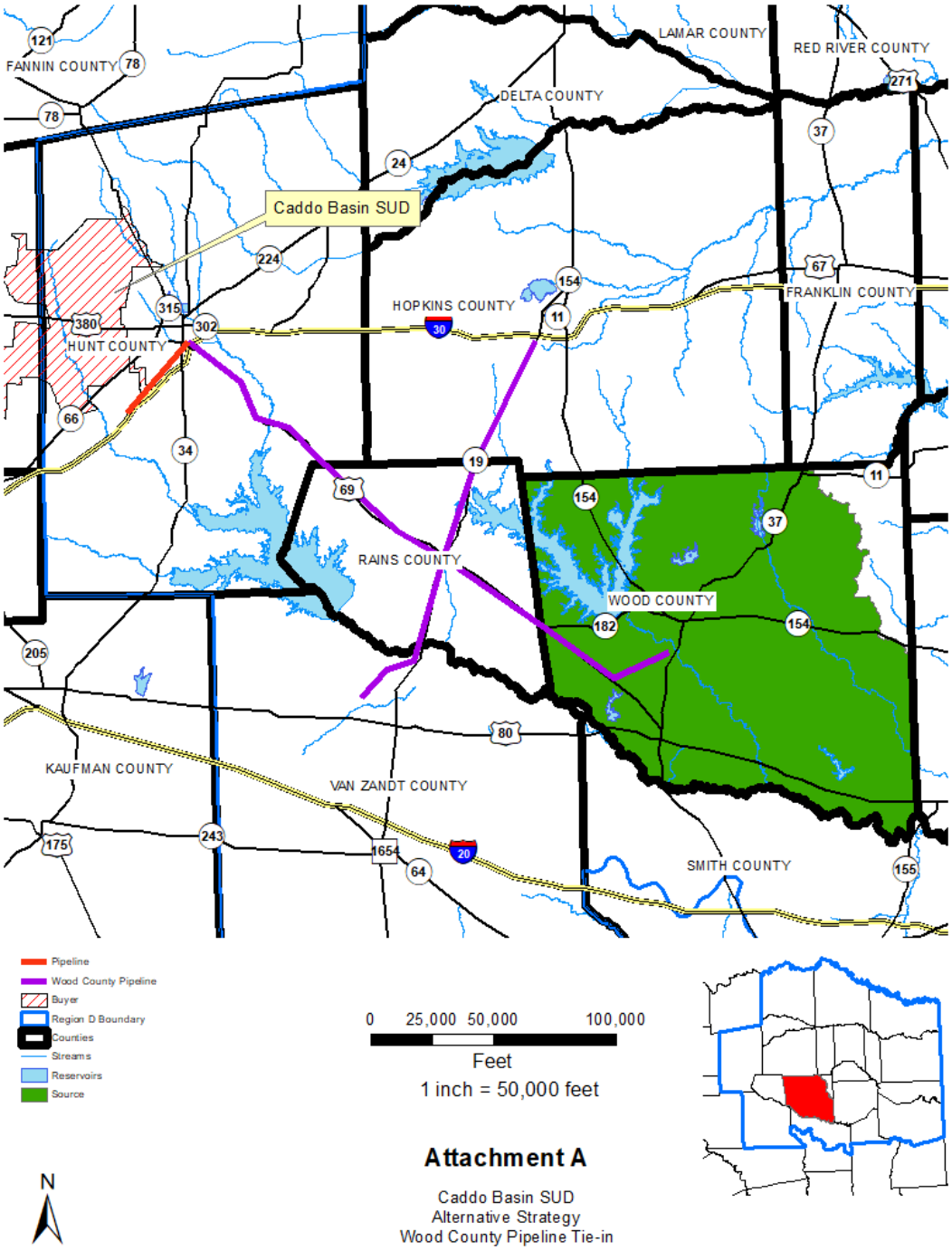
Seven alternative strategies were considered to meet the SUD's water supply shortages as summarized in the following table. Advanced conservation was not selected because the per capita use per day was less than the 140 gpcd threshold set by the water planning group; however, preliminary coordination with the Region C Planning Group indicates that conservation is a potential strategy for that portion of the WUG within the Region C planning area, thus conservation amounts identified by the Region C Planning Group have been incorporated herein for this WUG. Water reuse was not considered because the SUD does not have a demand for non-potable water. Groundwater was considered, but the SUD has previously indicated that it currently purchases treated water from NTMWD and is planning to meet its future needs from water purchases. Thus, the SUD could potentially increase existing contracts with NTMWD. Another potentially feasible contract increase could be from the City of Farmersville. The SUD also has an existing emergency interconnect with the City of Greenville, thus, a contract with the City of Greenville was considered. Another potentially feasible strategy is the Wood County Pipeline which could supply groundwater from Wood County.

| Strategy | Firm Yield (ac-ft) | Total Capital Cost | Total Annualized Cost | Unit Cost | Environmental Impact |
|---|---|---|---|---|---|
| Advanced Water Conservation (Region C Portion) | **18** | **$0** | **$0** | **$0** | **1** |
| Water Reuse | **0** | **-** | **-** | **-** | **-** |
| Ground Water (Hunt, Woodbine Aquifer, Trinity) | **0** | **-** | **-** | **-** | **-** |
| Increase Existing Contract (NTMWD) | **1,848** | **$0** | **$421,000** | **$228** | **1** |
| Increase Existing Contract (Farmersville) | **1,848** | **$0** | **$421,000** | **$228** | **1** |
| New Contract (Greenville) | **1,866** | **$2,473,000** | **$1,889,000** | **$1,012** | **1** |
| Wood County Pipeline | **1,866** | **$4,037,000** | **$3,059,000** | **$1,639** | **2** |

**Identified Alternative WMS and WMSP:**

| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Wood County Pipeline Tie-in** | 7 | 220 | 406 | 722 | 1,202 | 1,866 |

The identified Alternative Water Management Strategy for Caddo Basin SUD is the Wood County Pipeline Strategy, of which an Alternative Water Management Strategy Project is to construct, in association with B H P WSC and Poetry WSC, a 14" raw water line to tie into the Hunt County Branch of the Wood County Pipeline proposed to end near the City of Greenville. Cost estimates presented herein represent to total capital cost of the pipeline, which is to be proportionally shared with B H P WSC and Poetry WSC. The total annual cost and unit cost represent the debt service of the project as well as annual operation costs for conveyance of up to 1,866 ac-ft per year. This alternative strategy is contingent upon the regionalized development of a groundwater well field in Wood County and a conveyance pipeline from Wood County to Hunt County.




## Attachment A

Caddo Basin SUD
Alternative Strategy
Wood County Pipeline Tie-in

***Cost Estimate Summary***
***Water Supply Project Option***
***September 2018 Prices***

***B H P WSC, Caddo Basin SUD, Poetry WSC - Wood County Pipeline Tie-in***

***Cost based on ENR CCI 11170.28 for September 2018 and***
***a PPI of 201.9 for September 2018***

| ***Item*** | ***Estimated Costs for Facilities*** |
|---|---|
| Primary Pump Station (0 MGD) | $1,176,000 |
| Transmission Pipeline (0 in dia., miles) | $3,184,000 |
| **TOTAL COST OF FACILITIES** | **$4,360,000** |
| | |
| Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities) | $1,367,000 |
| Environmental & Archaeology Studies and Mitigation | $208,000 |
| Land Acquisition and Surveying (23 acres) | $124,000 |
| Interest During Construction (3% for 1 years with a 0.5% ROI) | $167,000 |
| **TOTAL COST OF PROJECT** | **$6,226,000** |
| | |
| **ANNUAL COST** | |
| Debt Service (3.5 percent, 20 years) | $438,000 |
| Operation and Maintenance | |
| Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities) | $32,000 |
| Intakes and Pump Stations (2.5% of Cost of Facilities) | $29,000 |
| Dam and Reservoir (1.5% of Cost of Facilities) | $0 |
| Water Treatment Plant | $0 |
| Advanced Water Treamtent Facility | $0 |
| Pumping Energy Costs (867231 kW-hr @ 0.08 $/kW-hr) | $69,000 |
| Purchase of Water (2878 acft/yr @ 1442 $/acft) | $4,150,000 |
| **TOTAL ANNUAL COST** | **$4,718,000** |
| | |
| **Available Project Yield (acft/yr)** | 2,878 |
| **Annual Cost of Water ($ per acft), based on PF=1** | $1,639 |
| **Annual Cost of Water After Debt Service ($ per acft), based on PF=1** | $1,487 |
| **Annual Cost of Water ($ per 1,000 gallons), based on PF=1** | $5.03 |
| **Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1** | $4.56 |

*JMP* *10/6/2019*

## EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF CADDO MILLS IN HUNT COUNTY

**Description of Water User Group:**

The City of Caddo Mills provides water service in Hunt County. This City's population was 1,338 in 2010 and is projected to increase to 1,710 by 2020 and 7,147 by 2070. The City purchases treated water from the City of Greenville and is projected to have a shortage beginning in 2030 based on the availability of current supplies to Greenville. Caddo Mills is projected to have a deficit of 1 ac-ft in 2030 increasing to a deficit of 254 ac-ft by 2070.

**Water Supply and Demand Analysis:**

| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Population** | 1,710 | 2,214 | 2,898 | 3,843 | 5,190 | 7,147 |
| **Projected Water Demand** | 152 | 187 | 237 | 310 | 417 | 573 |
| **Water Demand from other entities** | 0 | 0 | 0 | 0 | 0 | 0 |
| **Current Water Supply** | 178 | 186 | 201 | 242 | 309 | 319 |
| **Projected Supply Surplus (+) / Deficit (-)** | **26** | **-1** | **-36** | **-68** | **-108** | **-254** |

**Evaluation of Potentially Feasible Water Management Strategies:**

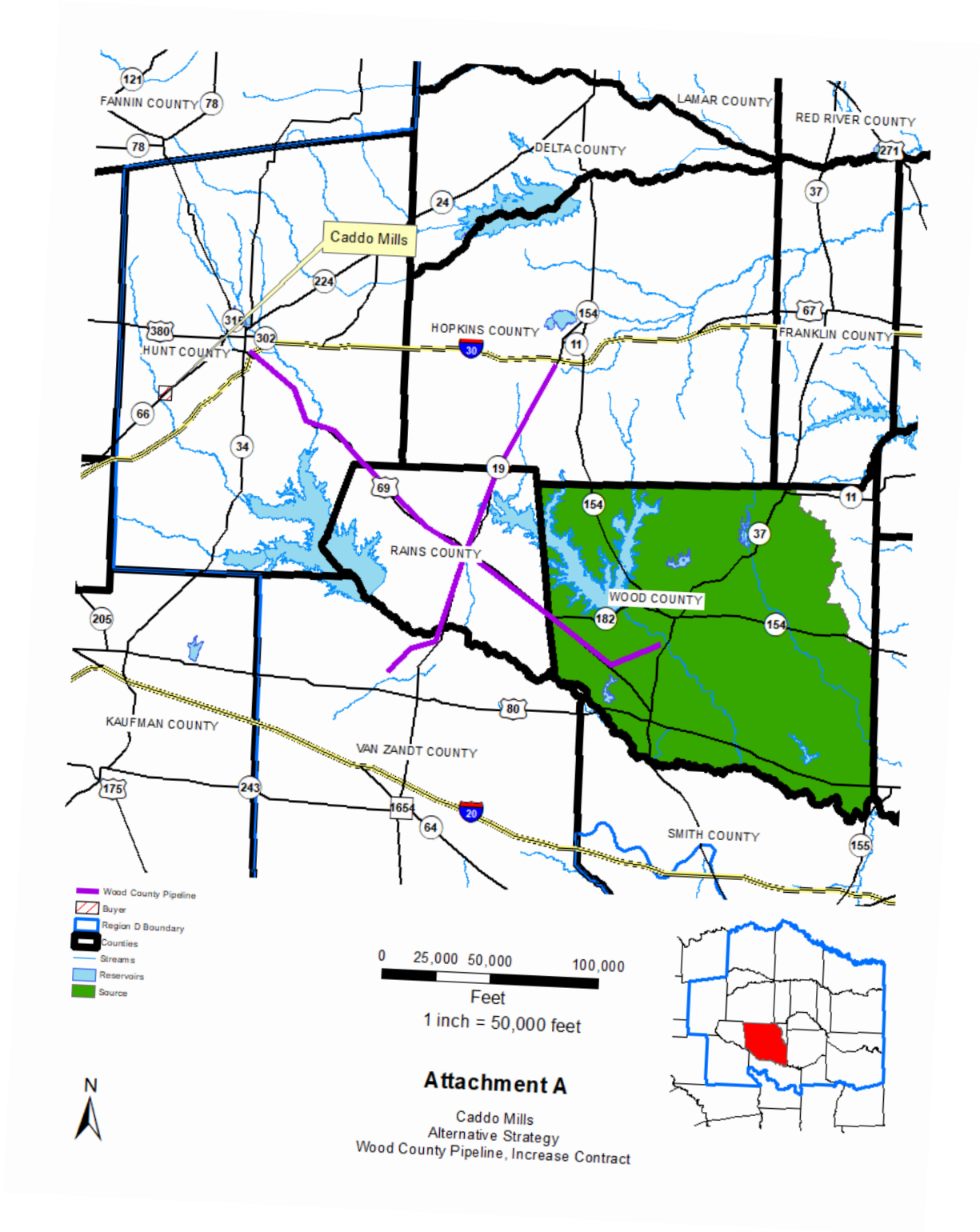
Four alternative strategies were considered to meet the City of Caddo Mills water supply shortages as summarized in the following table. Advanced conservation was not considered because the per capita use per day was below the 140 gpcd threshold set by the planning group. Water reuse was not considered because the City does not have a demand for non-potable water. Groundwater was considered, although the City has previously indicated that it plans to meet its future needs from water purchase from the City of Greenville. Another potentially feasible strategy is the Wood County Pipeline which could supply groundwater from Wood County via existing infrastructure from Greenville.

| Strategy | Firm Yield (ac-ft) | Total Capital Cost | Total Annualized Cost | Unit Cost | Environmental Impact |
|---|---|---|---|---|---|
| Advanced Water Conservation | | | | | |
| Water Reuse | | | | | |
| Drill New Wells (Hunt, Nacatoch Aquifer, Sabine Basin) | **254** | **$1,014,000** | **$221,000** | **$870** | **1** |
| Increase Existing Contract (Greenville) | **254** | **$0** | **$224,000** | **$882** | **1** |
| Wood County Pipeline, Increase Contract | **254** | **$0** | **$366,000** | **$1,442** | **2** |

**Identified Alternative WMS and WMSP:**

| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Wood County Pipelime, Increase Contract** | 0 | 1 | 36 | 68 | 108 | 254 |

The identified Alternative Water Management Strategy for the City of Caddo Mills to meet their projected deficit of 1 ac-ft/yr in 2030 and 254 ac-ft/yr in 2070 is the Wood County Pipeline Strategy, of which an Alternative Water Management Strategy Project is to increase the volume of treated surface water purchased from the City of Greenville via pass-through of the additional supply from this strategy to the City. This alternative strategy is contingent upon the regionalized development of a groundwater well field in Wood County and a conveyance pipeline from Wood County to Hunt County, as well as the recommended seller strategies of increased WTP capacity for the City of Greenville.




**Attachment A**

Caddo Mills
Alternative Strategy
Wood County Pipeline, Increase Contract

***Cost Estimate Summary***
***Water Supply Project Option***
***September 2018 Prices***

***Caddo Mills - Wood County Pipline, Increase Contract from Greenville***

***Cost based on ENR CCI 11170.28 for September 2018 and***
***a PPI of 201.9 for September 2018***

| *Item* | *Estimated Costs for Facilities* |
|---|---|
| **ANNUAL COST** | |
| Operation and Maintenance | |
| Intakes and Pump Stations (2.5% of Cost of Facilities) | $0 |
| Dam and Reservoir (1.5% of Cost of Facilities) | $0 |
| Water Treatment Plant | $0 |
| Advanced Water Treatment Facility | $0 |
| Pumping Energy Costs (0 kW-hr @ 0.08 $/kW-hr) | $0 |
| Purchase of Water (254 acft/yr @ 1442 $/acft) | $366,000 |
| **TOTAL ANNUAL COST** | **$366,000** |
| | |
| **Available Project Yield (acft/yr)** | 254 |
| **Annual Cost of Water ($ per acft), based on PF=1** | $1,441 |
| **Annual Cost of Water After Debt Service ($ per acft), based on PF=1** | $1,441 |
| **Annual Cost of Water ($ per 1,000 gallons), based on PF=1** | $4.42 |
| **Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1** | $4.42 |

*JMP* *10/3/2019*

## EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF CASH SUD IN HUNT COUNTY

### Description of Water User Group:

Cash SUD provides water in the south-central portion of Hunt County and small areas of northwestern Rains County, western Hopkins County, and eastern Rockwall County from purchased surface water supplies from the North Texas Municipal Water District (NTMWD) and the Sabine River Authority for supplies out of Lake Fork and Lake Tawakoni. Over 90% of the SUD's demand is located in Region D (Hunt County), with less than 10% in Region C (Rockwall County). In both regions, the system is projected to serve a total of 20,491 people in 2020 and 50,195 people by the year 2070. Cash SUD is projected to have a supply deficit of 111 ac-ft/yr by 2020 increasing to 1,860 ac-ft/yr by 2070.

### Water Supply and Demand Analysis:

In coordination with Cash SUD and Region C, the below summarization of Cash SUD supplies and demands has been developed.

**Cash Special Utility District (Region C & D)**

| (Values in Ac-Ft/Yr) | Projected Population and Demand | | | | | |
|---|---|---|---|---|---|---|
| | **2020** | **2030** | **2040** | **2050** | **2060** | **2070** |
| **Projected Region Population (C&D)** | **20,491** | **24,592** | **29,451** | **35,192** | **42,044** | **50,195** |
| Projected Region Population (D) | 19,271 | 23,012 | 27,462 | 32,789 | 39,180 | 46,841 |
| Projected Region Population (C) | 1,220 | 1,580 | 1,989 | 2,403 | 2,864 | 3,354 |
| | | | | | | |
| **Projected Water Demand** | | | | | | |
| Municipal Demand (Region D) | 2,213 | 2,560 | 2,998 | 3,548 | 4,228 | 5,049 |
| Municipal Demand (Region C) | 140 | 176 | 217 | 260 | 309 | 362 |
| ***Total Projected Total Demand*** | ***2,353*** | ***2,736*** | ***3,215*** | ***3,808*** | ***4,537*** | ***5,411*** |
| | | | | | | |
| **Currently Available Water Supplies** | | | | | | |
| North Texas Municipal Water District | 1,450 | 1,514 | 1,663 | 1,744 | 1,571 | 1,442 |
| Sabine River Authority (current and future) | 896 | 943 | 1,086 | 1,342 | 2,017 | 2,945 |
| ***Total Current Supplies*** | ***2,346*** | ***2,457*** | ***2,749*** | ***3,086*** | ***3,642*** | ***4,387*** |
| | | | | | | |
| ***Need (Demand - Current Supply)*** | ***7*** | ***279*** | ***466*** | ***722*** | ***895*** | ***1,024*** |
| | | | | | | |
| **Water Management Strategies** | | | | | | |
| Water Conservation | 5 | 7 | 9 | 11 | 14 | 18 |
| Increase Contract with NTMWD | 2 | 272 | 457 | 711 | 881 | 1,006 |
| *Additional Delivery Infrastructure from NTMWD* | *2* | *272* | *457* | *711* | *881* | *1,006* |
| Wood County Pipeline (Alt Region D Needs) | 0 | 0 | 466 | 722 | 895 | 373 |
| ***Total Water Management Strategies*** | ***7*** | ***279*** | ***466*** | ***722*** | ***895*** | ***1,024*** |

**Evaluation of Potentially Feasible Water Management Strategies:**

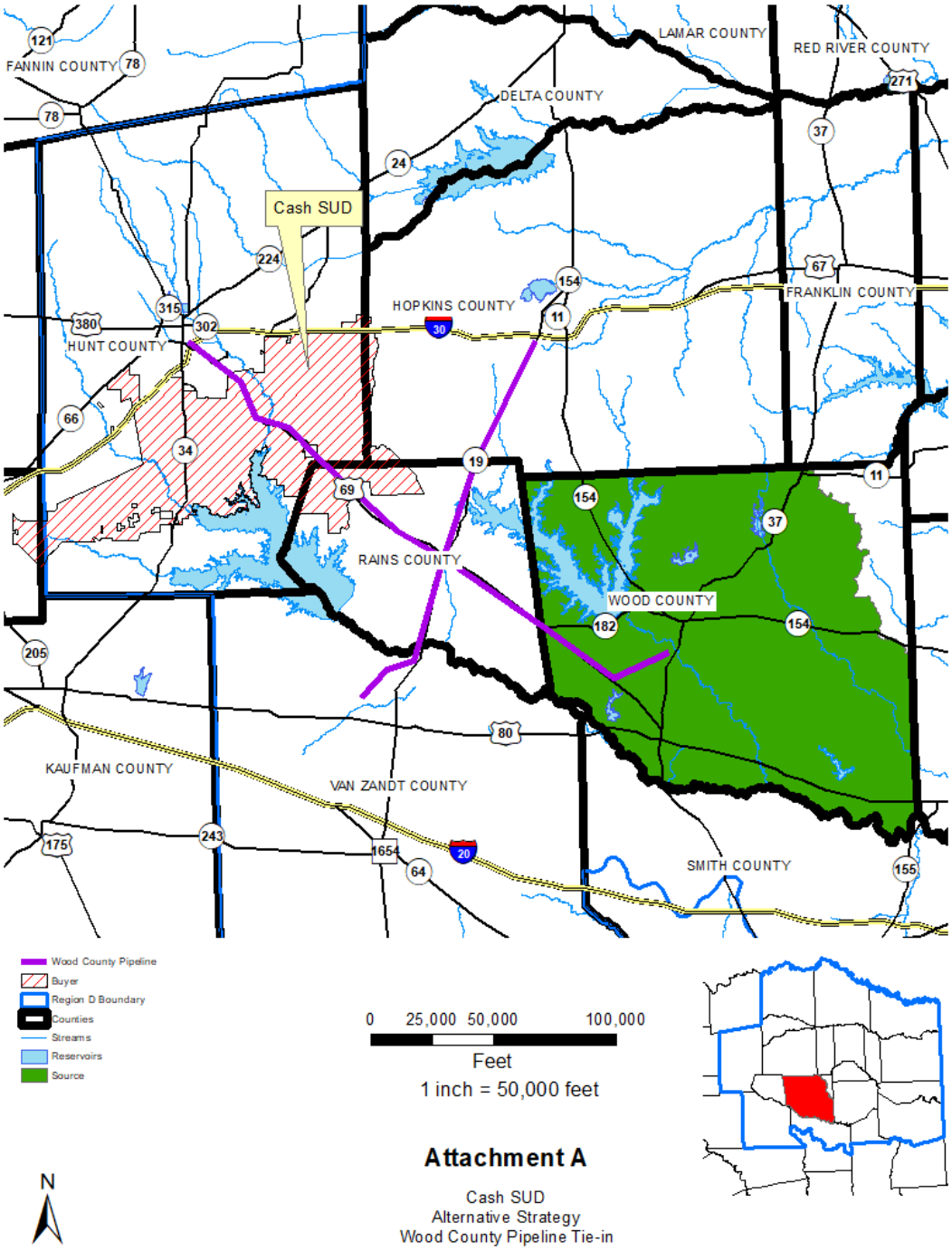
Cash SUD has a contract with NTMWD for 2.2 MGD (2,466 ac-ft/yr). Additional supply comes from the SRA. Cash SUD operates its own water treatment plant within Region D to treat the supply from SRA. The water management strategies for Cash SUD include conservation, acquisition of additional supplies from NTMWD, including additional delivery infrastructure. Another potentially feasible strategy is the Wood County Pipeline which could supply groundwater from Wood County.

| Strategy | Firm Yield (ac-ft) | Total Capital Cost | Total Annual Cost | Unit Cost | Environmental Impact |
|---|---|---|---|---|---|
| Advanced Water Conservation (Region C Portion) | **18** | | **$0** | **$0** | **1** |
| Water Reuse | | | | | |
| Increase contract w/ NTMWD (contingent upon Region C NTMWD WMS) | **1,006** | **$8,272,000** | **$2,155,000** | **$2,446** | **1** |
| Wood County Pipeline Tie-in | **881** | **$1,863,000** | **$1,433,000** | **$1,627** | **2** |

**Identified Alternative WMS and WMSP:**

| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Wood County Pipeline Tie-in** | **0** | **0** | **466** | **722** | **895** | **373** |

The identified Alternative Water Management Strategy for Cash SUD is the Wood County Pipeline Strategy, of which an Alternative Water Management Strategy Project is the construction of a 14" diameter raw water tie-in pipeline to the Hunt County Branch of the Wood County Pipeline. This alternative strategy is contingent upon the regionalized development of a groundwater well field in Wood County and a conveyance pipeline from Wood County to Hunt County.




**Attachment A**

Cash SUD
Alternative Strategy
Wood County Pipeline Tie-in

***Cost Estimate Summary***
***Water Supply Project Option***
***September 2018 Prices***

***Cash SUD - Wood County Pipeline Tie-in***

***Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018***

| *Item* | *Estimated Costs for Facilities* |
|---|---|
| Primary Pump Station (0 MGD) | $930,000 |
| Transmission Pipeline (0 in dia., miles) | $360,000 |
| **TOTAL COST OF FACILITIES** | **$1,290,000** |
| | |
| Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities) | $433,000 |
| Environmental & Archaeology Studies and Mitigation | $50,000 |
| Land Acquisition and Surveying (7 acres) | $40,000 |
| Interest During Construction (3% for 1 years with a 0.5% ROI) | $50,000 |
| **TOTAL COST OF PROJECT** | **$1,863,000** |
| | |
| **ANNUAL COST** | |
| Debt Service (3.5 percent, 20 years) | $131,000 |
| Operation and Maintenance | |
| Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities) | $4,000 |
| Intakes and Pump Stations (2.5% of Cost of Facilities) | $23,000 |
| Dam and Reservoir (1.5% of Cost of Facilities) | $0 |
| Water Treatment Plant | $0 |
| Advanced Water Treamtent Facility | $0 |
| Pumping Energy Costs (66031 kW-hr @ 0.08 $/kW-hr) | $5,000 |
| Purchase of Water (881 acft/yr @ 1442 $/acft) | $1,270,000 |
| **TOTAL ANNUAL COST** | **$1,433,000** |
| | |
| **Available Project Yield (acft/yr)** | 881 |
| **Annual Cost of Water ($ per acft), based on PF=2** | $1,627 |
| **Annual Cost of Water After Debt Service ($ per acft), based on PF=2** | $1,478 |
| **Annual Cost of Water ($ per 1,000 gallons), based on PF=2** | $4.99 |
| **Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=2** | $4.53 |

*JMP* *10/6/2019*

## EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF CITY OF CELESTE

**Description of Water User Group:**

The City of Celeste is a small public water supply located in northwest Hunt County. The system is projected to serve 1,012 people in 2020 and 3,658 people by the year 2070. The current sources of supply are two wells into the Woodbine Aquifer with production capacities of 150 gpm and 200 gpm. The City provides water to its own customers in the Sabine River Basin and is projected to have a water supply deficit of 29 ac-ft/yr in 2020 increasing to 316 ac-ft/yr by 2070.

**Water Supply and Demand Analysis:**

| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Population** | 1,012 | 1,257 | 1,590 | 2,051 | 2,706 | 3,658 |
| **Projected Water Demand** | 124 | 147 | 181 | 231 | 304 | 411 |
| **Water Demand from other entities** | 0 | 0 | 0 | 0 | 0 | 0 |
| **Current Water Supply** | 95 | 95 | 95 | 95 | 95 | 95 |
| **Projected Supply Surplus (+) / Deficit (-)** | **-29** | **-52** | **-86** | **-136** | **-209** | **-316** |

**Evaluation of Potentially Feasible Water Management Strategies:**

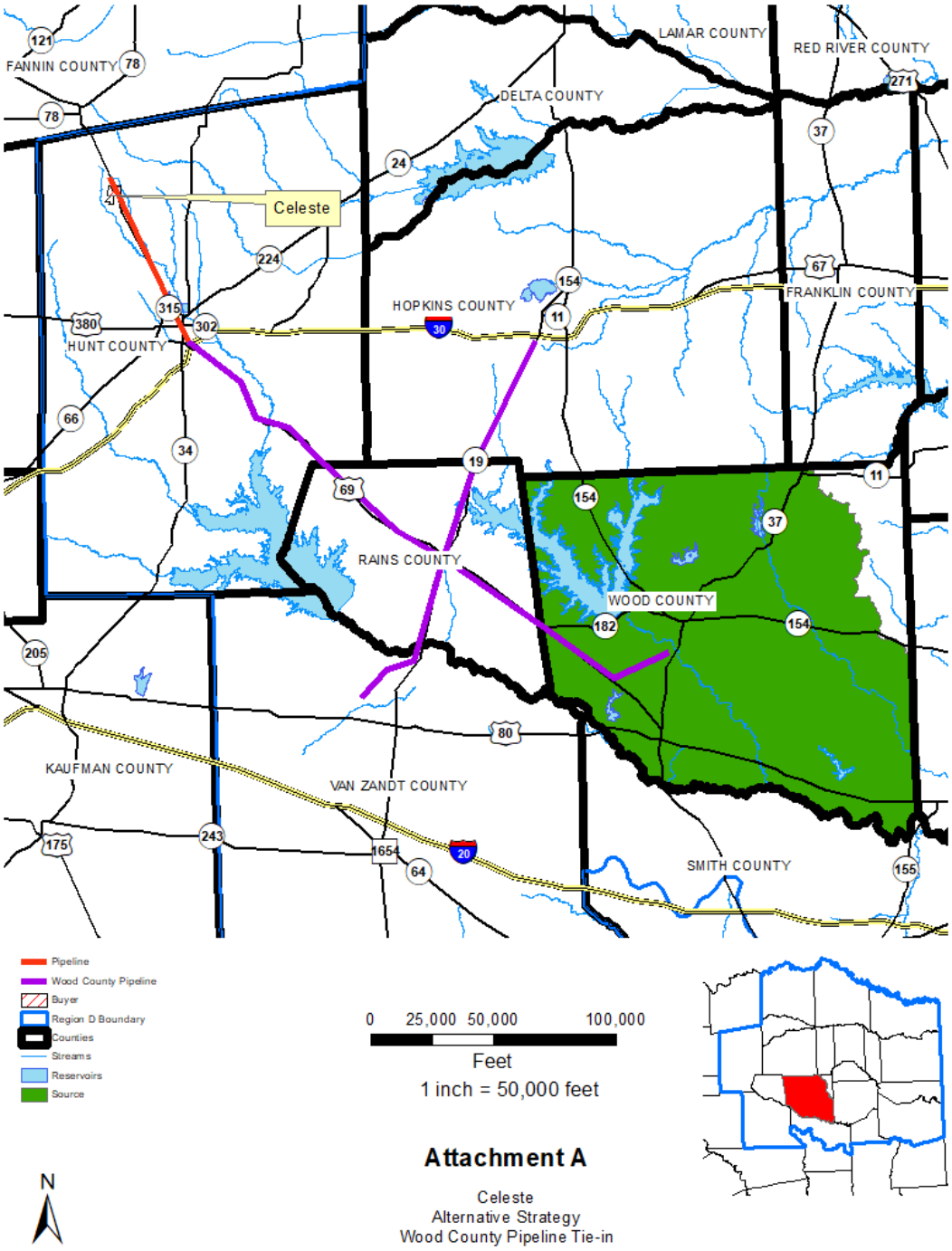
Multiple alternative strategies considered to meet Celeste's water supply shortages are listed in the table below. Advanced conservation was not selected since per capita use is less than 140 gpcd. The purchase of surface water from the City of Greenville and construction of a treated water pipeline was identified as a potentially feasible strategy and evaluated. Additional supplies from the City of Greenville would be contingent upon City of Greenville water strategies. Pumping of additional groundwater from the Woodbine Aquifer was also considered as an alternative for this entity. There is sufficient source availability in the Woodbine Aquifer through 2060, but if this alternative were to be implemented availability would be insufficient by 2070, which would necessitate a smaller contract and infrastructure for treated supply from the City of Greenville by 2070. Such an approach would be contingent upon recommended seller strategies for the City of Greenville. Another potentially feasible strategy is the Wood County Pipeline which could supply groundwater from Wood County.

| Strategy | Firm Yield (ac-ft) | Total Capital Cost | Total Annual Cost | Unit Cost | Environmental Impact |
|---|---|---|---|---|---|
| Advanced Water Conservation | | | | | |
| Water Reuse | | | | | |
| Drill New Wells (Woodbine, Sabine Basin) | | | | | |
| Drill New Wells (Woodbine, Sulphur Basin) | | | | | |
| Drill New Wells (Woodbine, Trinity Basin) | **229** | **$1,686,000** | **$292,000** | **$1,275** | **1** |
| New Contract and Treated Water Pipeline (Greenville, contingent on Seller WMS) | **87** | **$3,342,000** | **$341,000** | **$3,920** | **1** |
| New Contract and Treated Water Pipeline (Greenville contingent on Seller WMS) | **316** | **$5,076,000** | **$690,000** | **$2,184** | **1** |
| Wood County Pipeline Tie-in | **316** | **$5,076,000** | **$867,000** | **$2,744** | **2** |

**Identified Alternative WMS and WMSP:**

| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Wood County Pipeline Tie-in** | **29** | **52** | **86** | **136** | **209** | **316** |

The identified Alternative Water Management Strategy for the City of Celeste to meet their projected deficit of 29 ac-ft/yr in 2020 and 316 ac-ft/yr in 2070 is the Wood County Pipeline Strategy, of which an Alternative Water Management Strategy Project is to construct an 8" treated water pipeline from the City of Greenville's system to the City of Celeste and contracting for pass-through water supplies from the Wood County Pipeline delivered to the City of Greenville. This alternative strategy is contingent upon the regionalized development of a groundwater well field in Wood County and a conveyance pipeline from Wood County to Hunt County, as well as the recommended seller strategies of increased WTP capacity for the City of Greenville.




**Attachment A**

Celeste
Alternative Strategy
Wood County Pipeline Tie-in

***Cost Estimate Summary***
***Water Supply Project Option***
***September 2018 Prices***

***Celeste - Wood County Pipeline Tie-in via Greenville***

***Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018***

| *Item* | *Estimated Costs for Facilities* |
|---|---|
| Primary Pump Station (0 MGD) | $865,000 |
| Transmission Pipeline (0 in dia., miles) | $2,509,000 |
| **TOTAL COST OF FACILITIES** | **$3,374,000** |
| | |
| Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities) | $1,055,000 |
| Environmental & Archaeology Studies and Mitigation | $325,000 |
| Land Acquisition and Surveying (34 acres) | $186,000 |
| Interest During Construction (3% for 1 years with a 0.5% ROI) | $136,000 |
| **TOTAL COST OF PROJECT** | **$5,076,000** |
| | |
| **ANNUAL COST** | |
| Debt Service (3.5 percent, 20 years) | $357,000 |
| Operation and Maintenance | |
| Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities) | $25,000 |
| Intakes and Pump Stations (2.5% of Cost of Facilities) | $22,000 |
| Dam and Reservoir (1.5% of Cost of Facilities) | $0 |
| Water Treatment Plant | $0 |
| Advanced Water Treatment Facility | $0 |
| Pumping Energy Costs (85412 kW-hr @ 0.08 $/kW-hr) | $7,000 |
| Purchase of Water (316 acft/yr @ 1442 $/acft) | $456,000 |
| **TOTAL ANNUAL COST** | **$867,000** |
| | |
| **Available Project Yield (acft/yr)** | 316 |
| **Annual Cost of Water ($ per acft), based on PF=1** | $2,744 |
| **Annual Cost of Water After Debt Service ($ per acft), based on PF=1** | $1,614 |
| **Annual Cost of Water ($ per 1,000 gallons), based on PF=1** | $8.42 |
| **Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1** | $4.95 |

## EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF COUNTY-OTHER IN HUNT COUNTY

**Description of Water User Group:**

The County-Other WUG in Hunt County comprises all or portions of Campbell WSC, Jacobia WSC, City of Lone Oak, Maloy WSC, and Aqua Texas within Hunt County. The WUG population is projected to be 6,342 in 2020 and 58,270 by the year 2070. The WUG is supplied by groundwater from the Nacatoch, Trinity, and Woodbine Aquifers and purchases surface water from Cash SUD, City of Cooper, and City of Greenville. In Hunt County, the County-Other WUG is projected to have a deficit of 20 ac-ft in 2020 increasing to 283 ac-ft by 2070 within the Sulphur River Basin. Within the Sabine River Basin a deficit of 65 ac-ft is projected by 2040 increasing to 3,426 ac-ft by 2070. In the Trinity River Basin a deficit of 2 ac-ft is projected by 2030 increasing to 125 ac-ft by 2070.

**Water Supply and Demand Analysis:**

| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Population** | 6,342 | 11,000 | 17,951 | 23,690 | 36,034 | 58,270 |
| **Projected Water Demand** | 790 | 1,326 | 2,130 | 2,792 | 4,238 | 6,846 |
| **Water Demand from other entities** | 0 | 0 | 0 | 0 | 0 | 0 |
| **Current Water Supply** | 1,652 | 1,775 | 1,964 | 2,089 | 2,421 | 3,012 |
| **Projected Supply Surplus (+) / Deficit (-)** | **862** | **449** | **-166** | **-703** | **-1,817** | **-3,834** |

**Evaluation of Potentially Feasible Water Management Strategies:**

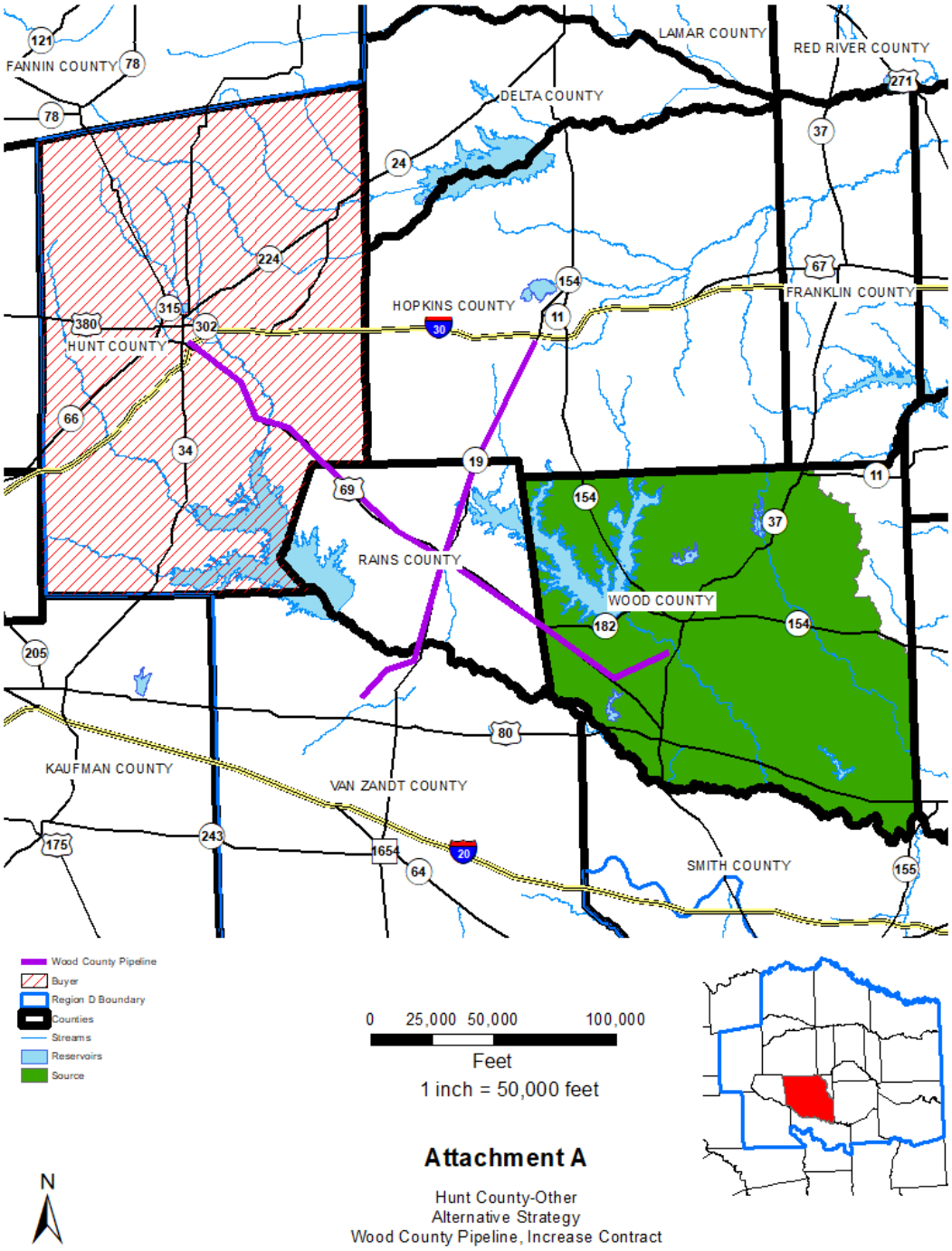
Multiple alternative strategies were considered to meet the WUG's water supply shortages as summarized in the following table. Advanced conservation was not considered because the per capita use per day was below the 140 gpcpd threshold set by the planning group. Water reuse is not a feasible option because water supply is mainly used for public consumption. Groundwater was identified as a potential source of water for Hunt County-Other, but the Nacatoch aquifer does not have sufficient availability to cover all shortages. Various sources of treated surface water are available to the entities in the County-Other WUG based on proximity and availability. Potential sources for contracted surface water include the City of Greenville, City of Commerce, Combined Consumers SUD, and City of West Tawakoni. Another potentially feasible strategy is the Wood County Pipeline which could supply groundwater from Wood County via existing infrastructure with the City of Greenville.

| Strategy | Firm Yield (ac-ft) | Total Capital Cost | Total Annualized Cost | Unit Cost | Environmental Impact |
|---|---|---|---|---|---|
| Advanced Water Conservation | | | | | |
| Water Reuse | | | | | |
| Drill New Wells (Nacatoch Aquifer, Sabine Basin) | **703** | **$8,609,000** | **$1,150,000** | **$1,636** | **1** |
| Increase Existing Contract with City of Greenville (contingent upon Greenville WMSs) | **3,834** | **$0** | **$3,385,000** | **$883** | **1** |
| Wood County Pipeline, Increase Contract | **3,834** | **$0** | **$5,529,000** | **$1,442** | **2** |

**Identified Alternative WMS and WMSP:**

| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Wood County Pipeline, Increase Contract** | 0 | 0 | 166 | 703 | 1,817 | 3,834 |

The identified Alternative Water Management Strategy for the Hunt County-Other WUG to meet their projected deficit of 166 ac-ft/yr in 2040 and 3,834 ac-ft/yr in 2070 is the Wood County Pipeline Strategy, of which an Alternative Water Management Strategy Project is to increase the volume of treated surface water by contracting for pass-through water supplies purchased from the City of Greenville, contingent upon additional supplies from the Wood County Pipeline delivered to the City of Greenville. This alternative strategy is contingent upon the regionalized development of a groundwater well field in Wood County and a conveyance pipeline from Wood County to Hunt County, as well as the recommended seller strategies of increased WTP capacity for the City of Greenville.




## Attachment A

Hunt County-Other
Alternative Strategy
Wood County Pipeline, Increase Contract

***Cost Estimate Summary***
***Water Supply Project Option***
***September 2018 Prices***

***Hunt County Other - Wood County Pipline, Increase Contract from Greenville***

***Cost based on ENR CCI 11170.28 for September 2018 and***
***a PPI of 201.9 for September 2018***

| *Item* | *Estimated Costs for Facilities* |
|---|---|
| **ANNUAL COST** | |
| Operation and Maintenance | |
| Intakes and Pump Stations (2.5% of Cost of Facilities) | $0 |
| Dam and Reservoir (1.5% of Cost of Facilities) | $0 |
| Water Treatment Plant | $0 |
| Advanced Water Treamtent Facility | $0 |
| Pumping Energy Costs (0 kW-hr @ 0.08 $/kW-hr) | $0 |
| Purchase of Water (3834 acft/yr @ 1442 $/acft) | $5,529,000 |
| **TOTAL ANNUAL COST** | **$5,529,000** |
| | |
| **Available Project Yield (acft/yr)** | 3,834 |
| **Annual Cost of Water ($ per acft), based on PF=1** | $1,442 |
| **Annual Cost of Water After Debt Service ($ per acft), based on PF=1** | $1,442 |
| **Annual Cost of Water ($ per 1,000 gallons), based on PF=1** | $4.42 |
| **Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1** | $4.42 |

*JMP* *10/4/2019*

## EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF CITY OF GREENVILLE

**Description of Water User Group:**

The City of Greenville provides water service in Hunt County. The WUG population is projected to be 29,871 in 2020 increasing to 77,705 by the year 2070. The City of Greenville uses surface water from Greenville's city lake and purchases surface water out of Lake Tawakoni from the Sabine River Authority. The City of Greenville sells water to the City of Caddo Mills, Shady Grove WSC and entities within Hunt County-Other, Manufacturing, Mining and Steam Electric WUGs in Hunt County. The City of Greenville is projected to have a deficit of -314 ac-ft in 2020 increasing to -11,816 ac-ft by 2070. When incorporating projected treated water demands of existing and potential customers, the projected deficit increases from -3,279 ac-ft in 2020 to 25,041 ac-ft in 2070.

**Water Supply and Demand Analysis:**

| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Population** | 29,871 | 34,309 | 40,330 | 48,645 | 60,491 | 77,705 |
| **Projected Water Demand** | 9,271 | 10,481 | 12,187 | 14,624 | 18,163 | 23,319 |
| **Existing Water Demand from other entities** | 2,431 | 2,608 | 2,807 | 3,022 | 3,213 | 3,410 |
| **Current Total (Raw & Treated) Water Supply** | 13,718 | 23,783 | 23,615 | 23,448 | 23,300 | 23,111 |
| **Projected Supply Surplus (+) / Deficit (-)** | **2,016** | **10,694** | **8,621** | **5,802** | **1,924** | **-3,618** |

| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Projected Greenville WUG Water Demand** | 9,271 | 10,481 | 12,187 | 14,624 | 18,163 | 23,319 |
| **Existing Water Demand from other entities** | 2,431 | 2,608 | 2,807 | 3,022 | 3,213 | 3,410 |
| **Existing Customer Projected Needs** | 0 | 1 | 202 | 771 | 1,925 | 4,088 |
| **Potential Customer Projected Needs** | 96 | 273 | 519 | 920 | 1,523 | 2,490 |
| **Current Treated Water Supply** | 8,090 | 8,090 | 8,090 | 8,090 | 8,090 | 8,090 |
| **Projected Treated Supply Surplus (+) / Deficit (-)** | **-3,335** | **-4,900** | **-7,252** | **-10,874** | **-16,361** | **-24,844** |

**Evaluation of Potentially Feasible Water Management Strategies:**

Multiple alternative strategies have been identified and evaluated to meet the City of Greenville's water supply shortages as summarized in the below table. Advanced conservation is recommended as the gpcd associated with the projected population and demand is approximately 277 gpcd. The City of Greenville's 2019 water conservation plan utilizes a base per capita water use of 156 gpcd. Thus, the recommended advanced water conservation strategy is to achieve the identified per capita water use of 156 gpcd. Water reuse was not considered because the City has not presently indicated an identified a demand for non-potable water. Groundwater was not determined to be feasible due to limited availability and the City's current utilization of surface water supplies.

Potentially feasible surface water strategies include the purchase of water out of Chapman Lake from either the City of Sulphur Springs and/or NTMWD, and purchase of raw water from the Sabine River Authority's proposed Toledo Bend Transfer. To utilize the City of Sulphur Springs supply from Chapman Lake, one strategy would necessitate that the City construct an intake structure, pump station, pipeline, and new Water Treatment Plant (WTP) to bring water from Chapman Lake to the City. The City is also presently evaluating

the feasibility of a water swap whereby the City would obtain NTMWD supply from Chapman Lake (via construction of a tie-in pipeline to NTWMD's existing raw water line) in a 1-to-1 exchange for Greenville's supply from Lake Tawakoni. Since this strategy would not produce additional supply for the City, it has not been included herein as a feasible strategy to produce additional supply. However, given the identified need, a strategy to purchase supply from NTMWD and construct a tie-in pipeline has been identified and evaluated. Additionally, according to preliminary discussions with Region C, Phase 1 of the Toledo Bend Transfer is currently not being considered until 2070, and was thus not considered a feasible alternative for Greenville until 2070.

Because the City of Greenville currently provides wholesale water to a number of entities in the surrounding area, shortages for Caddo Mills, Hunt County-Other, Hickory Creek SUD (a potential new customer), the City of Wolfe City (a potential new customer) and the City of Celeste (a potential new customer) were included in the analysis of needed supply for Greenville under the assumption that Greenville could sell treated and untreated water, as needed, to these other entities.

The City of Greenville's existing water treatment plant was expanded in 1993-1994 to a capacity of 13 MGD. Based on TWDB projections, the City will need to expand the WTP by 2030 to accommodate projected demand for the City and its customers. With an assumed peaking factor of 1.8, expanding the WTP to include an additional 15 MGD of capacity will ensure adequate capacity through 2060. By 2070, the City will need to construct an additional new WTP with a total production capacity of 15 MGD to meet projected demands of the City and its customers.

To meet projected demands for the City along with the other existing and potential customers, the City of Greenville would need to implement a voluntary reallocation of surplus supplies to Hunt County Manufacturing.

Projected demands for Steam Electric power generation are associated with a proposed 1,750 MW combined cycle generation facility at Greenville. This facility was announced in 2002, but has not yet been constructed. The facility has been estimated to require approximately 4,000 acre-feet per year of supply, while the projections for Steam Electric water demand in Hunt County range from 12,400 ac-ft in 2020 to 28,500 ac-ft in 2070. Because of the uncertainty in demand and when this facility will be constructed, for the purposes of the 2021 Plan, Steam Electric demands have not been included in the strategy for the City of Greenville. Depending on the actual demand, the City may need to construct a pipeline to other water resources earlier than the 2070 planning horizon.

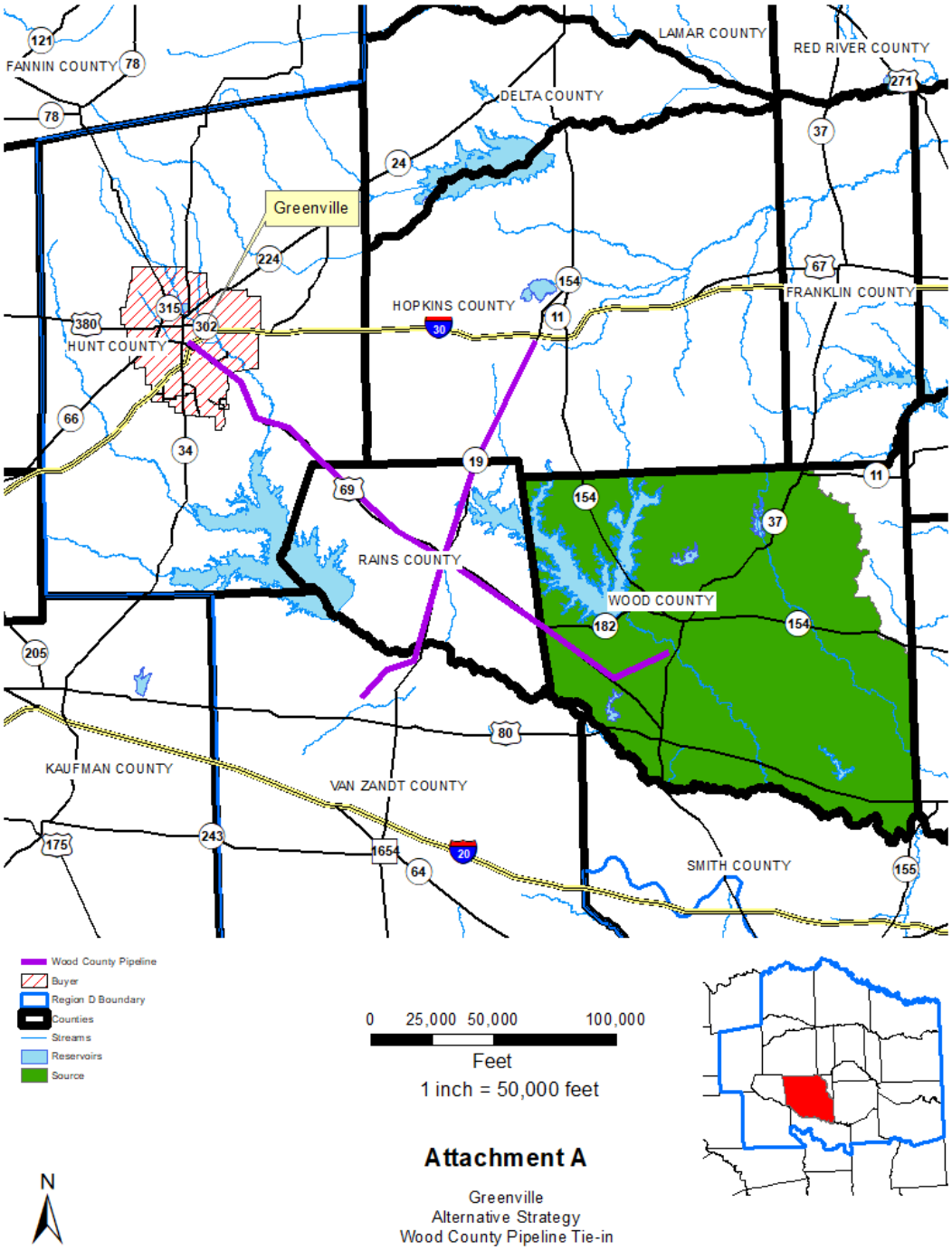
Another potentially feasible strategy is the Wood County Pipeline which could supply groundwater from Wood County.

| Strategy | Firm Yield (ac-ft) | Start Year | Total Capital Cost | Total Annualized Cost | Unit Cost | Env. Impact |
|---|---|---|---|---|---|---|
| Advanced Water Conservation | **9,741** | **2020** | **0** | **$6,633,000** | **$681** | |
| Water Reuse | | | | | | |
| Ground Water | | | | | | |
| Voluntary Reallocation of Hunt County Other Surplus purchased from Greenville (purchased from SRA Tawakoni; ac-ft/yr) | 354 | 2020 | $0 | $0 | $0 | 1 |
| Voluntary Reallocation of Hunt Manufacturing Surplus purchased from Greenville (purchased from SRA Tawakoni; ac-ft/yr) | 455 | 2070 | $0 | $0 | $0 | 1 |
| WTP Expansion (15 MGD) | 9,335 | 2030 | $43,955,000 | $5,309,000 | $569 | 2 |
| New WTP (15 MGD) | 9,335 | 2070 | $81,786,000 | $9,880,000 | $1,058 | 2 |
| Chapman Intake, Pump Station, and Raw Water Pipeline (contingent on City of Sulphur Springs Strategies) | 500 | 2070 | $60,235,000 | $4,851,000 | $9,702 | 3 |
| Toledo Bend Tie-In Pipeline | 500 | 2070 | $12,559,000 | $1,112,000 | $2,224 | 3 |
| Chapman Raw Water Tie-In Pipeline (purchase from NTMWD) | 500 | 2070 | $10,389,000 | $945,000 | $1,890 | 3 |
| Wood County Pipeline Tie-in | 6,491 | 2020 | $0 | $9,360,000 | $1,442 | 2 |

**Identified Alternative WMS and WMSP:**

| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Wood County Pipeline Tie-in** | **96** | **274** | **721** | **1,691** | **3,448** | **6,491** |

The identified Alternative Water Management Strategy for the City of Greenville is the Wood County Pipeline Strategy, whereby the City would potentially serve as a delivery junction for existing and potential future customers throughout Hunt County. The identified Alternative Water Management Strategy Project is to tie into the Hunt County Branch of the Wood County Pipeline. The strategy volumes identified herein represent supplies sufficient to meet the needs of Caddo Mills, Hunt County-Other, Hickory Creek SUD, and Wolfe City. Needs for the City of Greenville itself do not necessitate additional source availability. This alternative strategy is contingent upon the regionalized development of a groundwater well field in Wood County and a conveyance pipeline from Wood County to Hunt County, as well as the recommended seller strategies of increased WTP capacity for the City of Greenville.




## Attachment A

Greenville
Alternative Strategy
Wood County Pipeline Tie-in

***Cost Estimate Summary***
***Water Supply Project Option***
***September 2018 Prices***

***Greenville Area - Wood County Pipeline Tie-in***

***Cost based on ENR CCI 11170.28 for September 2018 and***
***a PPI of 201.9 for September 2018***

| *Item* | *Estimated Costs for Facilities* |
|---|---|
| **ANNUAL COST** | |
| Operation and Maintenance | |
| Intakes and Pump Stations (2.5% of Cost of Facilities) | $0 |
| Dam and Reservoir (1.5% of Cost of Facilities) | $0 |
| Water Treatment Plant | $0 |
| Advanced Water Treatment Facility | $0 |
| Pumping Energy Costs (0 kW-hr @ 0.08 $/kW-hr) | $0 |
| Purchase of Water (6491 acft/yr @ 1442 $/acft) | $9,360,000 |
| **TOTAL ANNUAL COST** | **$9,360,000** |
| | |
| **Available Project Yield (acft/yr)** | 6,491 |
| **Annual Cost of Water ($ per acft), based on PF=1** | $1,442 |
| **Annual Cost of Water After Debt Service ($ per acft), based on PF=1** | $1,442 |
| **Annual Cost of Water ($ per 1,000 gallons), based on PF=1** | $4.42 |
| **Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1** | $4.42 |

*JMP* *10/6/2019*

**EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF HICKORY CREEK SUD IN HUNT COUNTY**

**Description of Water User Group:**

Hickory Creek SUD provides water in northwestern Hunt County and small areas of eastern Collin and southern Fannin counties from four wells in the Woodbine Aquifer in Hunt County, having a total rated capacity of 1402 gpm, or 754 ac-ft/yr. The projected water groundwater availability limits this supply to approximately 349 ac-ft/yr based on Modeled Available Groundwater (MAG) results. Over 90% of the SUD's demand is located in Region D (Hunt County), with less than 10% in Region C (Collin and Fannin Counties). In both regions, the system is projected to serve a total of 4,673 people in 2020 and 26,582 people by the year 2070. The population and demand projections for the system are shown in the table below. In Hunt County, Hickory Creek SUD is projected to have a water supply deficit of 105 ac-ft/yr by 2020 increasing to 2,030 ac-ft/yr by 2070 In Collin and Fannin Counties the projected deficit totals 11 ac-ft in 2020 increasing to 85 ac-ft by 2070.

**Water Supply and Demand Analysis:**

| | **2020** | **2030** | **2040** | **2050** | **2060** | **2070** |
|---|---|---|---|---|---|---|
| **Population** | 4,673 | 6,721 | 9,477 | 13,289 | 18,715 | 26,582 |
| **Projected Water Demand** | 465 | 641 | 888 | 1,234 | 1,735 | 2,463 |
| **Water Demand from other entities** | 0 | 0 | 0 | 0 | 0 | 0 |
| **Current Water Supply** | 369 | 368 | 369 | 368 | 369 | 368 |
| **Projected Supply Surplus (+) / Deficit (-)** | **-96** | **-273** | **-519** | **-866** | **-1,366** | **-2,095** |

| **Projected Supply Surplus (+) / Deficit (-) by Basin** | **2020** | **2030** | **2040** | **2050** | **2060** | **2070** |
|---|---|---|---|---|---|---|
| **Sabine** | -32 | -114 | -228 | -393 | -629 | -977 |
| **Sulphur** | -36 | -91 | -172 | -285 | -451 | -692 |
| **Trinity** | -17 | -45 | -85 | -142 | -223 | -341 |
| **Total** | **-96** | **-273** | **-519** | **-866** | **-1,366** | **-2,095** |

**Evaluation of Potentially Feasible Water Management Strategies:**

The multiple alternative strategies considered to meet Hickory Creek SUD's water supply shortages are listed in the table below. Advanced conservation was not selected since per capita use is less than 140 gpcd. There are no significant current water needs that could be met by water reuse. Groundwater from the Woodbine Aquifer was considered because the SUD is currently using this aquifer as the source of supply for the system. Although the MAG indicates limited supply (349 ac-ft/yr by 2020), the existing production capacity of the Hickory Creek SUD is 810 ac-ft/yr (502 gpm as noted in the TCEQ PWS database). Full use of the existing system (up to an additional 462 ac-ft/yr) could meet projected demands through 2030; however, due to the limited availability of this groundwater source and lack of supporting available technical information, this aquifer is not projected to have sufficient supply to meet all of Hickory Creek SUD's shortage over the 2040-2070 period. Similarly, there are potentially available supplies from the Nacatoch Aquifer, however supplies are limited and insufficient considering other WUG's which may also seek to develop the supply. Additional supplies are limited from the Trinity Aquifer in Hunt County to satisfy the remainder of Hickory Creek SUD's needs.

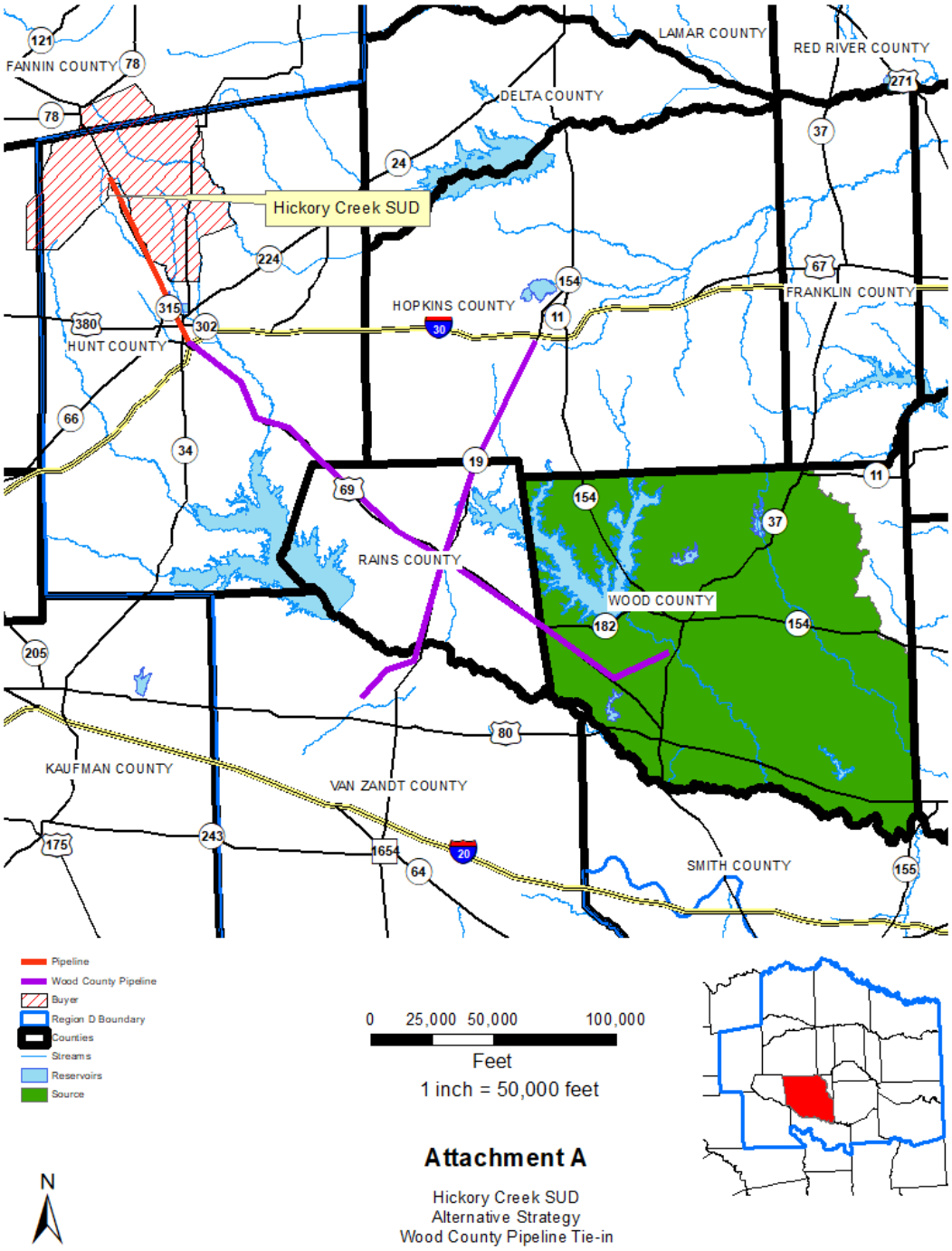
Although the SUD has previously indicated that it would continue adding wells to meet future demands, given the aforementioned present limitations regarding groundwater source availability, surface water sources were investigated to meet long-term projected water needs for the SUD. Another potentially feasible regional groundwater strategy evaluated herein is the Wood County Pipeline, which could supply groundwater from Wood County.

| Strategy | Firm Yield (ac-ft) | Total Capital Cost | Total Annual Cost | Unit Cost | Environmental Impact |
|---|---|---|---|---|---|
| Advanced Water Conservation | | | - | | |
| Water Reuse | | | | | |
| Drill New Wells (Woodbine Aquifer, Sabine Basin) | **75** | **$763,000** | **$120,000** | **$1,600** | **1** |
| Drill New Wells (Woodbine Aquifer, Trinity Basin) | **230** | **$2,358,000** | **$348,000** | **$1,513** | **1** |
| Greenville Tie-In Pipeline | **2,095** | **$8,553,000** | **$2,595,000** | **$1,239** | **2** |
| Wood County Pipeline Tie-in | **2,095** | **$11,862,000** | **$4,030,000** | **$1,924** | **2** |

**Identified Alternative WMS and WMSP:**

| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Wood County Pipeline Tie-in** | **96** | **273** | **519** | **866** | **1,366** | **2,095** |

The identified Alternative Water Management Strategy for the Hickory Creek SUD to meet their projected deficit of 96 ac-ft/yr in 2020 and 2,095 ac-ft/yr in 2070 is the Wood County Pipeline Strategy, of which an Alternative Water Management Strategy Project is to construct a 16" treated water pipeline to the City of Greenville's system and contracting for pass-through water supplies from the Wood County Pipeline delivered to the City of Greenville. This alternative strategy is contingent upon the regionalized development of a groundwater well field in Wood County and a conveyance pipeline from Wood County to Hunt County, as well as the recommended seller strategies of increased WTP capacity for the City of Greenville.




## Attachment A

Hickory Creek SUD
Alternative Strategy
Wood County Pipeline Tie-in

***Cost Estimate Summary***
***Water Supply Project Option***
***September 2018 Prices***

***Hickory Creek SUD - Wood County Pipeline Tie-in***

***Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018***

| *Item* | *Estimated Costs for Facilities* |
|---|---|
| Primary Pump Station (0 MGD) | $1,178,000 |
| Transmission Pipeline (0 in dia., miles) | $7,202,000 |
| **TOTAL COST OF FACILITIES** | **$8,380,000** |
| | |
| Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities) | $2,573,000 |
| Environmental & Archaeology Studies and Mitigation | $378,000 |
| Land Acquisition and Surveying (39 acres) | $213,000 |
| Interest During Construction (3% for 1 years with a 0.5% ROI) | $318,000 |
| **TOTAL COST OF PROJECT** | **$11,862,000** |
| | |
| **ANNUAL COST** | |
| Debt Service (3.5 percent, 20 years) | $835,000 |
| Operation and Maintenance | |
| Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities) | $72,000 |
| Intakes and Pump Stations (2.5% of Cost of Facilities) | $29,000 |
| Dam and Reservoir (1.5% of Cost of Facilities) | $0 |
| Water Treatment Plant | $0 |
| Advanced Water Treamtent Facility | $0 |
| Pumping Energy Costs (909484 kW-hr @ 0.08 $/kW-hr) | $73,000 |
| Purchase of Water (2095 acft/yr @ 1442 $/acft) | $3,021,000 |
| **TOTAL ANNUAL COST** | **$4,030,000** |
| | |
| **Available Project Yield (acft/yr)** | 2,095 |
| **Annual Cost of Water ($ per acft), based on PF=1** | $1,924 |
| **Annual Cost of Water After Debt Service ($ per acft), based on PF=1** | $1,525 |
| **Annual Cost of Water ($ per 1,000 gallons), based on PF=1** | $5.90 |
| **Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1** | $4.68 |

*JMP* *10/6/2019*

## EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF MINING IN HUNT COUNTY

**Description of Water User Group:**

Mining in Hunt County has a demand that is projected to decrease from 128 ac-ft/yr in 2020 to 47 ac-ft/yr in 2070. Mining in Hunt County is currently supplied by groundwater from the Nacatoch Aquifer and water purchased from the City of Greenville from Lake Tawakoni.

**Water Supply and Demand Analysis:**

| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Projected Water Demand** | 128 | 118 | 88 | 71 | 58 | 47 |
| **Current Water Supply** | 55 | 54 | 53 | 52 | 51 | 50 |
| **Projected Supply Surplus (+)/Deficit(-)** | **-73** | **-64** | **-35** | **-19** | **-7** | **3** |

| **Projected Supply Surplus (+)/Deficit(-) by Basin** | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Sabine** | -41 | -35 | -16 | -5 | 0 | 3 |
| **Sulphur** | -30 | -27 | -18 | -13 | -7 | 0 |
| **Trinity** | -2 | -2 | -1 | -1 | 0 | 0 |
| **Total** | **-73** | **-64** | **-35** | **-19** | **-7** | **3** |

**Evaluation of Potentially Feasible Water Management Strategies:**

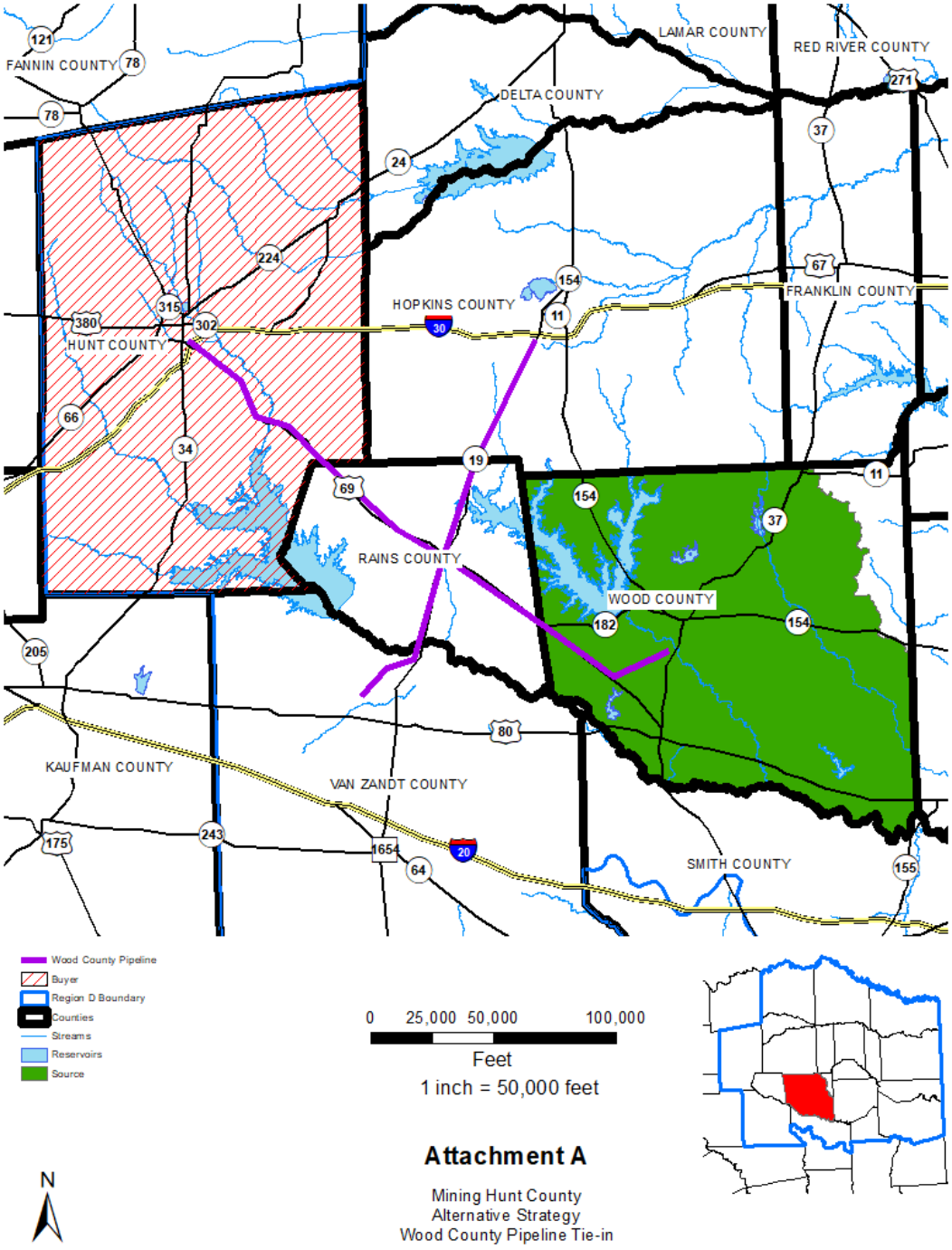
Twelve alternative strategies were considered to meet the Hunt County Mining water supply shortages as summarized in the following table. Advanced conservation and water reuse were not considered because operational procedures for the existing mines are not available. Groundwater has been identified as a potential source of water for mining in Hunt County, with focus given to accessible sources with availability within MAG estimates. Surface water via contracting with the City of Sulphur Springs was also considered as a viable alternative to meet projected demands. Another potentially feasible strategy is the Wood County Pipeline.

| Strategy | Firm Yield (AF) | Total Capital Cost | Total Annualized Cost | Unit Cost | Env. Impact |
|---|---|---|---|---|---|
| Advanced Water Conservation | | | | | |
| Water Reuse | | | | | |
| Drill New Wells (Nacatoch, Sabine Basin) | | | | | |
| Drill New Wells (Trinity, Sabine Basin) | **73** | **$766,000** | **$101,000** | **$1,384** | **1** |
| Drill New Wells (Woodbine, Sabine Basin) | | | | | |
| Drill New Wells (Nacatoch, Sulphur Basin) | | | | | |
| Drill New Wells (Trinity, Sulphur Basin) | | | | | |
| Drill New Wells (Woodbine, Sulphur Basin) | | | | | |
| Drill New Wells (Trinity, Trinity Basin) | | | | | |
| Drill New Wells (Woodbine, Trinity Basin) | | | | | |
| New Contract with Sulphur Springs | **73** | **$560,000** | **$133,000** | **$1,822** | **1** |
| Wood County Pipeline Tie-in | **73** | **$560,000** | **$152,000** | **$2,082** | **2** |

**Identified Alternative WMS and WMSP:**

| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Wood County Pipeline Tie-in** | **73** | **64** | **35** | **19** | **7** | **0** |

The identified Alternative Water Management Strategy for the Hunt County Mining WUG to meet their projected deficit of 73 ac-ft/yr in 2020 is the Wood County Pipeline Strategy, of which an Alternative Water Management Strategy Project is to construct a 6" raw water pipeline to tie into the Wood County Pipeline. This WMSP assumes the need for a one mile long pipeline to transport water supply from the Wood County Pipeline to the use location. This alternative strategy is contingent upon the regionalized development of a groundwater well field in Wood County and a conveyance pipeline from Wood County to Hunt County.



***Cost Estimate Summary***
***Water Supply Project Option***
***September 2018 Prices***

***Hunt County Mining - Wood County Pipeline Via Greenville***

***Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018***

| *Item* | *Estimated Costs for Facilities* |
|---|---|
| Primary Pump Station (0 MGD) | $227,000 |
| Transmission Pipeline (0 in dia., miles) | $134,000 |
| **TOTAL COST OF FACILITIES** | **$361,000** |
| | |
| Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities) | $120,000 |
| Environmental & Archaeology Studies and Mitigation | $40,000 |
| Land Acquisition and Surveying (7 acres) | $24,000 |
| Interest During Construction (3% for 1 years with a 0.5% ROI) | $15,000 |
| **TOTAL COST OF PROJECT** | **$560,000** |
| | |
| **ANNUAL COST** | |
| Debt Service (3.5 percent, 20 years) | $39,000 |
| Operation and Maintenance | |
| Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities) | $1,000 |
| Intakes and Pump Stations (2.5% of Cost of Facilities) | $6,000 |
| Dam and Reservoir (1.5% of Cost of Facilities) | $0 |
| Water Treatment Plant | $0 |
| Advanced Water Treamtent Facility | $0 |
| Pumping Energy Costs (7553 kW-hr @ 0.08 $/kW-hr) | $1,000 |
| Purchase of Water (73 acft/yr @ 1442 $/acft) | $105,000 |
| **TOTAL ANNUAL COST** | **$152,000** |
| | |
| **Available Project Yield (acft/yr)** | 73 |
| **Annual Cost of Water ($ per acft), based on PF=1** | $2,082 |
| **Annual Cost of Water After Debt Service ($ per acft), based on PF=1** | $1,548 |
| **Annual Cost of Water ($ per 1,000 gallons), based on PF=1** | $6.39 |
| **Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1** | $4.75 |

*JMP* *9/30/2019*

**EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF NORTH HUNT SUD IN HUNT COUNTY**

**Description of Water User Group:**

North Hunt SUD provides water service in Hunt, Fannin, and Delta counties. It is projected North Hunt SUD will have a shortage in 2020. The WUG population is projected to be 4,333 in 2020 and 16,222 by the year 2070. The SUD has a contract for water supply with the City of Commerce for 147 ac-ft/yr, a well in Hunt County with a rating of 170 gpm, and a well in Fannin County that is rated at 318 gpm. In Hunt County, the SUD is projected to have a deficit of 72 ac-ft in 2020 increasing to 831 ac-ft by 2070. The remainder of the SUD is projected to have a deficit of 17 ac-ft in 2020 increasing to 57 ac-ft by 2070.

**Water Supply and Demand Analysis:**

| North Hunt SUD in Hunt County | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Population** | 4,333 | 5,469 | 6,976 | 9,035 | 11,973 | 16,222 |
| **Projected Water Demand** | 291 | 367 | 468 | 607 | 805 | 1,090 |
| **Water Demand from other entities** | 0 | 0 | 0 | 0 | 0 | 0 |
| **Current Water Supply** | 202 | 202 | 202 | 202 | 202 | 202 |
| **Projected Supply Surplus (+) / Deficit (-)** | **-89** | **-165** | **-266** | **-405** | **-603** | **-888** |

**Evaluation of Potentially Feasible Water Management Strategies:**

The six alternative strategies considered to meet North Hunt SUD's water supply shortages are listed in the table below. Advanced conservation was not selected because the per capita use per day was less than the 140 gpcd threshold set by the water planning group. Reuse is not a feasible option because water supply is mainly used for public consumption. Groundwater from the Woodbine Aquifer was considered because North Hunt SUD is currently using this aquifer as a source of supply for the system. However, due to the limited availability of this groundwater source, this aquifer will not be able to meet all of North Hunt SUD's shortage. Additional groundwater supplies are available from the Nacatoch Aquifer has been evaluated as well.

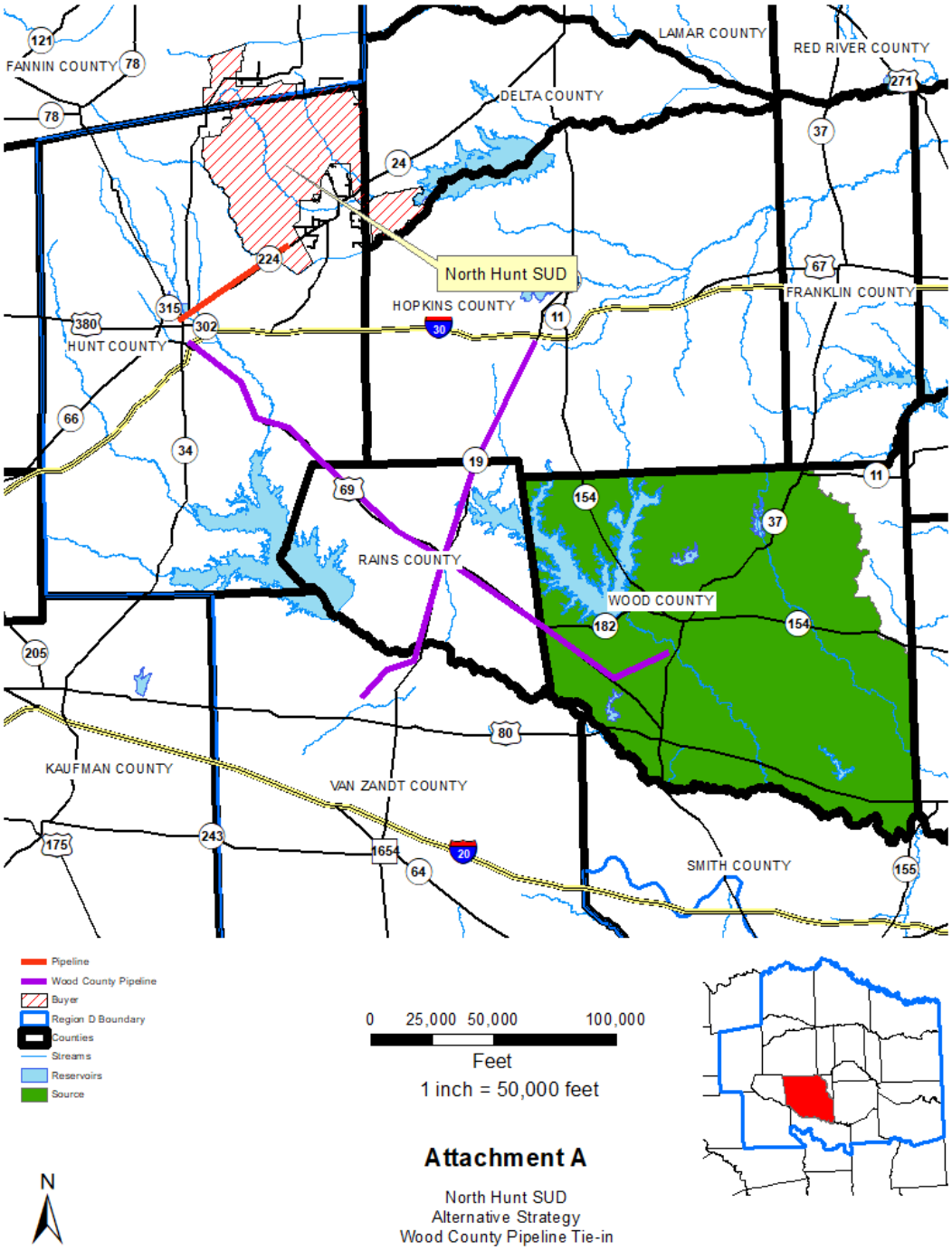
Additional purchase of water from the City of Commerce is another alternative; however, Commerce has only a limited volume, potentially available only if existing supplies to the Manufacturing WUG and the Delta County-Other WUG can be reallocated. A separate feasible strategy was considered to utilize surplus supply from Delta County MUD. The North Hunt SUD service area is contiguous with the service area for Delta County MUD, which purchases Big Creek Lake supply from the City of Cooper. North Hunt SUD could contract with the City of Cooper for water supplies from Big Creek Lake, transported via the existing connection between the City of Cooper and Delta County MUD. This strategy would require a pipeline connecting the two systems of sufficient size to provide available supplies and may require a permit amendment for additional yield potentially available from Big Creek Lake. Another potentially feasible strategy is the Wood County Pipeline which could supply groundwater from Wood County.

| Strategy | Firm Yield (ac-ft) | Total Capital Cost | Total Annualized Cost | Unit Cost | Env. Impact |
|---|---|---|---|---|---|
| Advanced Water Conservation | | | | | |
| Water Reuse | | | | | |
| Drill New Wells (Nacatoch Aquifer, Sabine Basin) | **888** | **$10,998,000** | **$1,458,000** | **$1,642** | **1** |
| Increase Contract w/ Commerce contingent on Commerce Seller Strategy | **888** | **$0** | **$963,000** | **$1,084** | **1** |
| Delta County Pipeline contingent on purchase from Delta County MUD for supply from Big Creek | **100** | **$6,058,000** | **$601,000** | **$6,010** | **3** |
| Wood County Pipeline Tie-in | **888** | **$6,777,000** | **$1,845,000** | **$2,078** | **2** |

**Identified Alternative WMS and WMSP:**

| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Wood County Pipeline Tie-in** | 89 | 165 | 266 | 405 | 603 | 888 |

The identified Alternative Water Management Strategy for the North Hunt SUD is the Wood County Pipeline Strategy, of which an Alternative Water Management Strategy Project is to construct a 12” water line to tie into the Hunt County Branch of the Wood County Pipeline near the City of Greenville. This alternative strategy is contingent upon the regionalized development of a groundwater well field in Wood County and a conveyance pipeline from Wood County to Hunt County.




## Attachment A

North Hunt SUD
Alternative Strategy
Wood County Pipeline Tie-in

***Cost Estimate Summary***
***Water Supply Project Option***
***September 2018 Prices***

***North Hunt SUD - Wood County Pipeline Tie-in***

***Cost based on ENR CCI 11170.28 for September 2018 and***
***a PPI of 201.9 for September 2018***

| *Item* | *Estimated Costs for Facilities* |
|---|---|
| Primary Pump Station (0 MGD) | $979,000 |
| Transmission Pipeline (0 in dia., miles) | $3,713,000 |
| **TOTAL COST OF FACILITIES** | **$4,692,000** |
| | |
| Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities) | $1,457,000 |
| Environmental & Archaeology Studies and Mitigation | $283,000 |
| Land Acquisition and Surveying (30 acres) | $163,000 |
| Interest During Construction (3% for 1 years with a 0.5% ROI) | $182,000 |
| **TOTAL COST OF PROJECT** | **$6,777,000** |
| | |
| **ANNUAL COST** | |
| Debt Service (3.5 percent, 20 years) | $477,000 |
| Operation and Maintenance | |
| Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities) | $37,000 |
| Intakes and Pump Stations (2.5% of Cost of Facilities) | $24,000 |
| Dam and Reservoir (1.5% of Cost of Facilities) | $0 |
| Water Treatment Plant | $0 |
| Advanced Water Treamtent Facility | $0 |
| Pumping Energy Costs (340634 kW-hr @ 0.08 $/kW-hr) | $27,000 |
| Purchase of Water (888 acft/yr @ 1442 $/acft) | $1,280,000 |
| **TOTAL ANNUAL COST** | **$1,845,000** |
| | |
| **Available Project Yield (acft/yr)** | 888 |
| **Annual Cost of Water ($ per acft), based on PF=1** | $2,078 |
| **Annual Cost of Water After Debt Service ($ per acft), based on PF=1** | $1,541 |
| **Annual Cost of Water ($ per 1,000 gallons), based on PF=1** | $6.38 |
| **Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1** | $4.73 |

*JMP* *10/6/2019*

## EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF POETRY WATER SUPPLY CORPORATION

**Description of Water User Group:**

Poetry Water Supply Corporation (WSC) is located in southwestern Hunt County and northern Kaufman County and is situated in the Sabine and Trinity River Basins. Poetry WSC is projected to serve 3,212 people by 2020, and the population is expected to increase to 11,937 by the year 2070. The WSC's current source of supply is treated water purchased from the City of Terrell. Poetry WSC is projected to have a deficit of 4 ac-ft/yr in 2020, up to 564 ac-ft/yr in 2070. There is a small supply that is not utilized by the WSC and could postpone supply deficits until 2030.

**Water Supply and Demand Analysis:**

| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Population** | 3,212 | 4,045 | 5,070 | 6,595 | 8,868 | 11,937 |
| **Projected Water Demand** | 353 | 430 | 528 | 681 | 913 | 1,228 |
| **Water Demand from other entities** | 0 | 0 | 0 | 0 | 0 | 0 |
| **Current Water Supply** | 355 | 364 | 413 | 481 | 583 | 718 |
| **Projected Supply Surplus (+) / Deficit (-)** | **2** | **-66** | **-115** | **-200** | **-330** | **-510** |

**Evaluation of Potentially Feasible Water Management Strategies:**

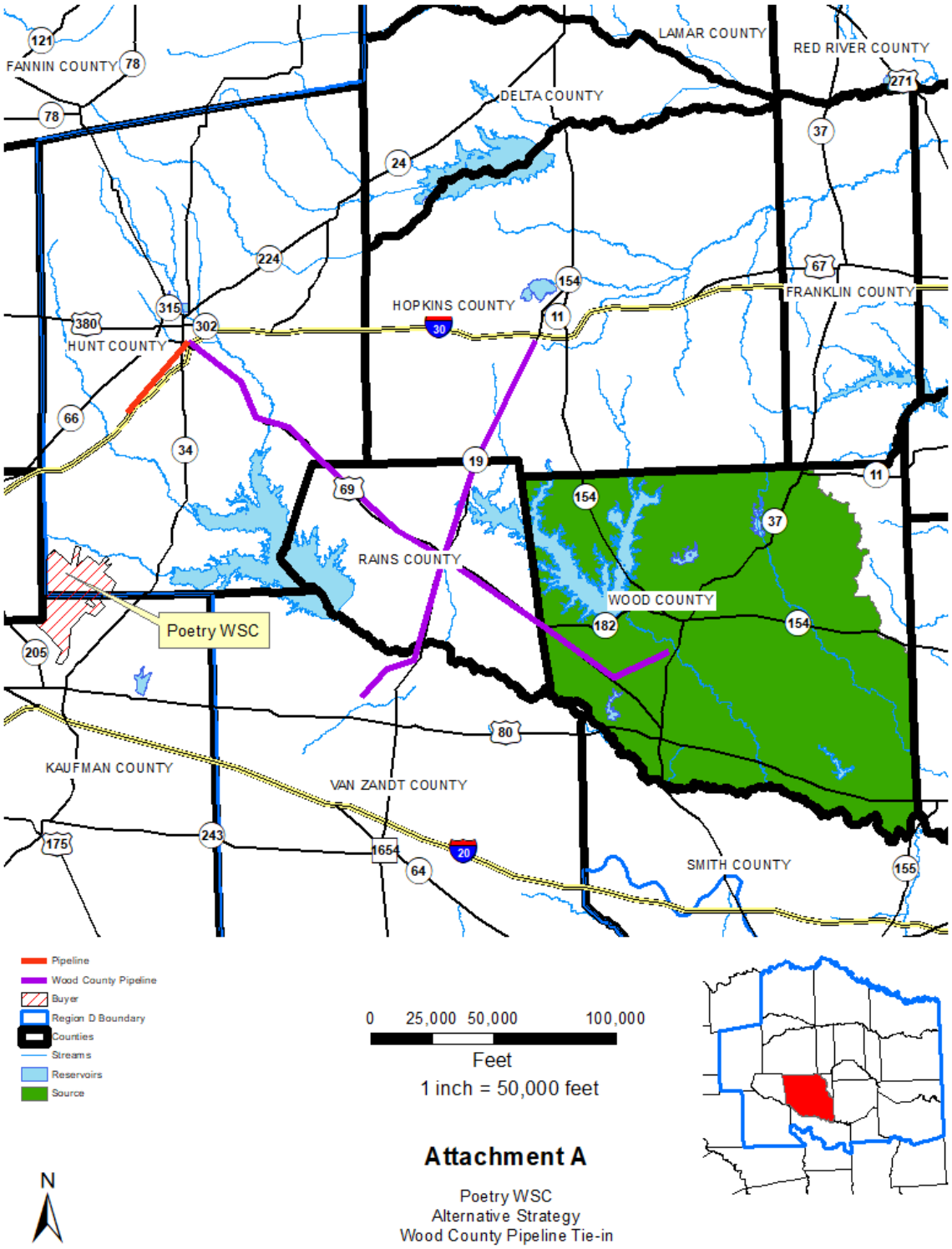
Listed in the table below are the five strategies that were considered to meet the water supply needs of Poetry WSC. There are no significant current water needs that could be met by water reuse. Advanced conservation was not selected because the per capita use per day was less than the 140 gpcd threshold set by the water planning group; however, preliminary coordination with the Region C Planning Group indicates that conservation is a potential strategy for that portion of the WUG within the Region C planning area, thus conservation amounts identified by the Region C Planning Group have been incorporated herein for this WUG. An identified feasible strategy is to increase the existing contract with Terrell via Sabine River Authority voluntary reallocation of Combined Consumers SUD surplus. The City of Terrell obtains a portion of its supply from Lake Fork via purchase from the Sabine River Authority. Combined Consumers SUD also purchases Lake Fork supply from the Sabine River Authority. A second feasible strategy is that since the City of Terrell also obtains a portion of its supply from the NTMWD reservoir system via purchase from the NTMWD, Cash SUD could increase its contract with the City of Terrell contingent upon a City of Terrell seller strategy to increase its contract with NTMWD, contingent upon recommended Region C NTMWD seller strategies. Development of groundwater supplies from the Nacatoch Aquifer, Sabine River Basin, was evaluated as a potentially cost effective approach for this entity. Another potentially feasible strategy is the Wood County Pipeline which could supply groundwater from Wood County.

| Strategy | Firm Yield (ac-ft) | Total Capital Cost | Total Annual Cost | Unit Cost | Environmental Impact |
|---|---|---|---|---|---|
| Advanced Water Conservation (Region C Portion) | **7** | | **$0** | **$0** | **1** |
| Water Reuse | | | | | |
| Increase contract w/ Terrell (contingent upon Region C NTMWD WMS) | **503** | | **$864,000** | **$1,718** | **1** |
| Increase contract w/ Terrell (contingent upon Voluntary Reallocation of Combined Consumers SUD Surplus) | **503** | | **$864,000** | **$1,718** | **1** |
| Drill Wells (Nacatoch Aquifer, Sabine Basin) | **564** | **$1,689,000** | **$449,000** | **$796** | **1** |
| Wood County Pipeline Tie-in | **510** | **$1,103,000** | **$836,000** | **$1,639** | **2** |

**Identified Alternative WMS and WMSP:**

| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Wood County Pipeline Tie-in** | **0** | **66** | **115** | **200** | **330** | **510** |

The identified Alternative Water Management Strategy for the Poetry WSC is the Wood County Pipeline Strategy, of which an Alternative Water Management Strategy Project is to construct, in association with B H P WSC and Caddo Basin SUD, a 14" raw water line to tie into the Hunt County Branch of the Wood County Pipeline proposed to end near the City of Greenville. Cost estimates presented herein represent to total capital cost of the pipeline, which is to be proportionally shared with B H P WSC and Caddo Basin SUD. The total annual cost and unit cost represent the debt service of the project as well as annual operation cost for conveyance of up to 510 ac-ft per year. This alternative strategy is contingent upon the regionalized development of a groundwater well field in Wood County and a conveyance pipeline from Wood County to Hunt County.




## Attachment A

Poetry WSC
Alternative Strategy
Wood County Pipeline Tie-in

***Cost Estimate Summary***
***Water Supply Project Option***
***September 2018 Prices***

***B H P WSC, Caddo Basin SUD, Poetry WSC - Wood County Pipeline Tie-in***

***Cost based on ENR CCI 11170.28 for September 2018 and***
***a PPI of 201.9 for September 2018***

| ***Item*** | ***Estimated Costs for Facilities*** |
|---|---|
| Primary Pump Station (0 MGD) | $1,176,000 |
| Transmission Pipeline (0 in dia., miles) | $3,184,000 |
| **TOTAL COST OF FACILITIES** | **$4,360,000** |
| | |
| Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities) | $1,367,000 |
| Environmental & Archaeology Studies and Mitigation | $208,000 |
| Land Acquisition and Surveying (23 acres) | $124,000 |
| Interest During Construction (3% for 1 years with a 0.5% ROI) | $167,000 |
| **TOTAL COST OF PROJECT** | **$6,226,000** |
| | |
| **ANNUAL COST** | |
| Debt Service (3.5 percent, 20 years) | $438,000 |
| Operation and Maintenance | |
| Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities) | $32,000 |
| Intakes and Pump Stations (2.5% of Cost of Facilities) | $29,000 |
| Dam and Reservoir (1.5% of Cost of Facilities) | $0 |
| Water Treatment Plant | $0 |
| Advanced Water Treamtent Facility | $0 |
| Pumping Energy Costs (867231 kW-hr @ 0.08 $/kW-hr) | $69,000 |
| Purchase of Water (2878 acft/yr @ 1442 $/acft) | $4,150,000 |
| **TOTAL ANNUAL COST** | **$4,718,000** |
| | |
| **Available Project Yield (acft/yr)** | 2,878 |
| **Annual Cost of Water ($ per acft), based on PF=1** | $1,639 |
| **Annual Cost of Water After Debt Service ($ per acft), based on PF=1** | $1,487 |
| **Annual Cost of Water ($ per 1,000 gallons), based on PF=1** | $5.03 |
| **Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1** | $4.56 |

*JMP* *10/6/2019*

## EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF THE CITY OF WOLFE CITY

**Description of Water User Group:**

The City of Wolfe City is located in northern Hunt County and is situated in the Sulphur River Basin. Wolfe City is bound on the west side by the Hickory Creek SUD, and the City of Commerce is located southeast of the City. The system is projected to serve 1,810 people by 2020, and the population is expected to increase to 6,547 by the year 2070. Wolfe City's current source of supply comes from two city lakes located on Turkey Creek in the South Sulphur River Basin. The City also has a 150 gpm well in the Woodbine formation, Sulphur River Basin, which has been brought back for use. Yield from the local lakes is calculated as 200 ac-ft/yr through 2070. Based on these yields, the quantity of water from the lakes will not be sufficient to meet projected demands. Wolfe City is projected to have a deficit of 54 ac-ft/yr in 2050, up to 308 ac-ft/yr in 2070.

**Water Supply and Demand Analysis:**

| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Population** | 1,810 | 2,249 | 2,846 | 3,669 | 4,842 | 6,547 |
| **Projected Water Demand** | 178 | 209 | 256 | 327 | 431 | 581 |
| **Water Demand from other entities** | 0 | 0 | 0 | 0 | 0 | 0 |
| **Current Water Supply** | 274 | 273 | 274 | 273 | 274 | 273 |
| **Projected Supply Surplus (+) / Deficit (-)** | **96** | **64** | **18** | **-54** | **-157** | **-308** |

**Evaluation of Potentially Feasible Water Management Strategies:**

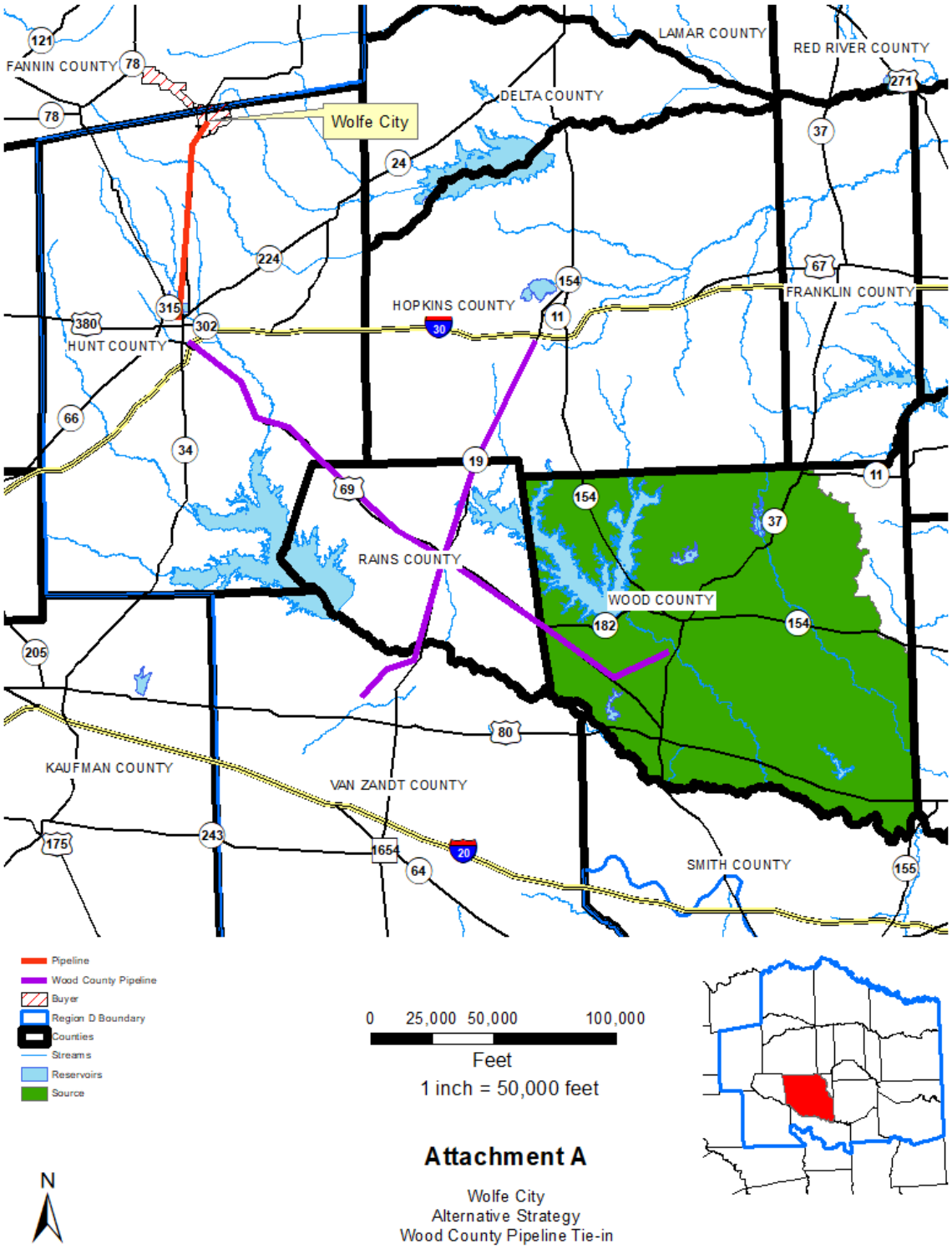
Listed in the table below are the multiple strategies that were considered to meet water supply needs in Wolfe City. Advanced conservation was not selected since per capita use is less than 140 gpcd. There are no significant current water needs that could be met by water reuse. The system has a number of surface water options, including connection to the City of Commerce, City of Greenville, and the proposed Ralph Hall Reservoir in Region C. Groundwater from the Woodbine Aquifer, Sulphur River Basin, was evaluated as a potentially cost effect approach for this entity. Another potentially feasible strategy is the Wood County Pipeline which could supply groundwater from Wood County.

| Strategy | Firm Yield (ac-ft) | Total Capital Cost | Total Annual Cost | Unit Cost | Environmental Impact |
|---|---|---|---|---|---|
| Advanced Water Conservation | | | | | |
| Water Reuse | | | | | |
| Drill New Wells (Woodbine Aquifer, Sulphur Basin) | | | | | |
| Greenville Tie-In Pipeline (contingent on Seller Strategies) | **308** | **$7,124,000** | **$846,000** | **$2,747** | **1** |
| Wood County Pipeline Tie-In | **308** | **$7,124,000** | **$1,018,000** | **$3,305** | **2** |

**Identified Alternative WMS and WMSP:**

| | 2010 | 2020 | 2030 | 2040 | 2050 | 2060 |
|---|---|---|---|---|---|---|
| **Wood County Pipeline Tie-In** | 0 | 0 | 0 | 54 | 157 | 308 |

The identified Alternative Water Management Strategy for the City of Wolfe City to meet their projected deficit of 54 ac-ft/yr in 2050 up to 308 ac-ft/yr in 2070 is the Wood County Pipeline Strategy, of which an Alternative Water Management Strategy Project is to construct a tie-in pipeline to the City of Greenville for the purchase of pass-through supplies made available from the Wood County Pipeline. This alternative strategy is contingent upon the regionalized development of a groundwater well field in Wood County and a conveyance pipeline from Wood County to Hunt County, as well as the recommended seller strategies of increased WTP capacity for the City of Greenville.




## Attachment A

Wolfe City
Alternative Strategy
Wood County Pipeline Tie-in

***Cost Estimate Summary***
***Water Supply Project Option***
***September 2018 Prices***

***Wolfe City - Wood County Pipeline Tie-In***

***Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018***

| *Item* | *Estimated Costs for Facilities* |
|---|---|
| Primary Pump Station (0 MGD) | $987,000 |
| Transmission Pipeline (0 in dia., miles) | $3,881,000 |
| **TOTAL COST OF FACILITIES** | **$4,868,000** |
| Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities) | $1,510,000 |
| Environmental & Archaeology Studies and Mitigation | $415,000 |
| Land Acquisition and Surveying (44 acres) | $140,000 |
| Interest During Construction (3% for 1 years with a 0.5% ROI) | $191,000 |
| **TOTAL COST OF PROJECT** | **$7,124,000** |
| **ANNUAL COST** | |
| Debt Service (3.5 percent, 20 years) | $501,000 |
| Operation and Maintenance | |
| Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities) | $39,000 |
| Intakes and Pump Stations (2.5% of Cost of Facilities) | $25,000 |
| Dam and Reservoir (1.5% of Cost of Facilities) | $0 |
| Water Treatment Plant | $0 |
| Advanced Water Treatment Facility | $0 |
| Pumping Energy Costs (113938 kW-hr @ 0.08 $/kW-hr) | $9,000 |
| Purchase of Water (308 acft/yr @ 1442 $/acft) | $444,000 |
| **TOTAL ANNUAL COST** | **$1,018,000** |
| **Available Project Yield (acft/yr)** | 308 |
| **Annual Cost of Water ($ per acft), based on PF=2** | $3,305 |
| **Annual Cost of Water After Debt Service ($ per acft), based on PF=2** | $1,679 |
| **Annual Cost of Water ($ per 1,000 gallons), based on PF=2** | $10.14 |
| **Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=2** | $5.15 |

*JMP* *10/5/2019*

REGION D
EVALUATIONS OF ALTERNATIVE WATER MANAGEMENT STRATEGIES
FOR MEETING PROJECTED WATER SUPPLY NEEDS
TO YEAR 2070

# RED RIVER COUNTY

*WUGs:*

The City of Clarksville
Red River County Irrigation

## EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF CITY OF CLARKSVILLE

**Description of Water User Group:**

The City of Clarksville is located in Red River County. The system is projected to serve 3,315 people through the planning period. The current sources of supply are wells into the Blossom Aquifer. Groundwater had previously been mixed with surface water from Langford Lake, however sedimentation has hindered its use as a water supply. Water quality issues with the groundwater (TDS) and surface water (turbidity) necessitate mixing of the supplies to meet Texas drinking water standards. The groundwater has over 1,000 ppm of dissolved solids including high levels of sodium, sulfate, and chloride. The City provides water to its own customers in the Sulphur basin and is projected to have a water supply deficit of 237 ac-ft/yr in 2020, due to sedimentation issues in Langford Lake. As the surface water supply for the City diminishes, the capability to mix the surface supply with the groundwater supply commensurately diminishes as well. Thus as surface supply diminishes, so too does the capability to utilize the City's existing groundwater supply. As noted in a 4 October, 2013 memorandum from the City's consultant, Murray, Thomas & Griffin, Inc. (MTG):

> "Clarksville has no available surface water when a water level of 417.0 (2006 low water level) and a sediment level at 415.0 (2013 lake bottom) are considered. Each of these conditions has occurred during the past ten years. The surface water is necessary to address total volume needs as well as for blending with the ground water."

For the current regional plan the City's water supply is solely from groundwater, thus the estimated deficit is reflective of the current groundwater production and treatment capacity without mixing of surface water. The system does have a water conservation and drought management plan in place.

**Water Supply and Demand Analysis:**

| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Population** | 3,315 | 3,315 | 3,315 | 3,315 | 3,315 | 3,315 |
| **Projected Water Demand** | 620 | 602 | 593 | 592 | 590 | 590 |
| **Water Demand from other entities** | 0 | 0 | 0 | 0 | 0 | 0 |
| **Current Water Supply** | 383 | 371 | 371 | 371 | 371 | 371 |
| **Projected Supply Surplus (+) / Deficit (-)** | **-237** | **-231** | **-222** | **-221** | **-219** | **-219** |

**Evaluation of Potentially Feasible Water Management Strategies:**

The various feasible strategies considered to meet Clarksville's water supply shortages are listed in the table below. Advanced conservation was not selected because Clarksville's supply would not be projected to meet TCEQ regulatory minimums. Furthermore, reduction in demand would not alleviate the aforementioned water quality issues with the City's projected supplies. There are no significant current water needs in Clarksville that could be met by water reuse. Additional groundwater pumping from the Blossom Aquifer in the Sulphur River Basin and Reverse Osmosis treatment of all of the City's existing groundwater supplies has also been considered. The City's existing surface water supply has been made unavailable due to sedimentation issues in Langford Lake, the City's sole existing surface water supply. The City has requested the consideration of multiple potential surface water strategies to meet Clarksville's water supply needs. Potentially feasible strategies evaluated include:

- Treated Water Pipeline to DeKalb - purchasing water from the City of Texarkana's available supply from Wright Patman Reservoir;
- Dredging of sediment from Langford Lake;
- Construction of a new surface water reservoir, Dimple Reservoir;
- Construction of a raw water pipeline tying into to Region C's proposed Marvin Nichols Reservoir.
- Treated Water Pipeline to Detroit - purchasing water from the City of Paris (via Lamar County WSD) from Paris available supply.

The projected amount of firm supply necessary to meet the above projected demands differ due to the City's current methodology of mixing their surface and groundwater supplies at a ratio of 51%.

| Strategy | Firm Yield (ac-ft) | Total Capital Cost | Total Annual Cost | Unit Cost (During Debt Service) | Unit Cost (After Debt Service | Env. Impact |
|---|---|---|---|---|---|---|
| Advanced Water Conservation | | | | | | |
| Water Reuse | | | | | | |
| Drill Additional Wells and RO Treatment | **388** | **$10,537,000** | **$1,673,000** | **$4,312** | **$2,402** | **2** |
| Raw Water Pipeline to Marvin Nichols Reservoir (ac-ft/yr) | | | | | | |
| Contract with Lamar County WSD | **303** | **$12,255,000** | **$1,518,000** | **$5,010** | **$2,165** | **3** |
| Contract with Riverbend WRD and Treated Water Pipeline to DeKalb (ac-ft/yr) | **303** | **$11,702,000** | **$1,171,000** | **$3,865** | **$1,149** | **2** |
| Dredge Langford Lake (ac-ft/yr) | **303** | **$36,200,000** | **$2,807,000** | **$5,398** | **$0** | **5** |
| Dimple Reservoir (ac-ft/yr) | **303** | **$38,489,000** | **$2,415,000** | **$7,970** | **$1,099** | **5** |

**Description of evaluated projects**

***Raw Water Pipeline to Marvin Nichols Reservoir*** – The City of Clarksville has requested that their top priority for consideration as a water management strategy be a pipeline tying into Region C's water management strategy for the construction of Marvin Nichols Reservoir (as it is reported in the Sulphur River Basin Feasibility Study, SRBA 2014, that 20% of the water potentially available from Marvin Nichols Reservoir would be available for local use in Region D). Preliminary communications with Region C have indicated that this strategy is currently under consideration as a Proposed or Alternative Water Management Strategy for implementation by the year 2060 in the 2021 Region C Water Plan. As Region D has identified that the City of Clarksville has needs as early as 2020, Marvin Nichols as currently envisioned by Region C would not be available to meet the City's identified needs. Furthermore, the North East Texas Regional Water Planning Group opposes the construction of any reservoir in the Sulphur River Basin, and does not recommend this as a Recommended or Alternative Water Management Strategy. However, the City of Clarksville has noted that should this source be available during the planning period, it has reserved the right to work with the Sulphur River Basin Authority and to utilize this source once available.

***New Groundwater Wells and Treatment Facility*** – A planning level analysis was performed to evaluate a strategy including the addition of new wells into the Nacatoch Aquifer, Sulphur River Basin, in Red River County, and additional treatment of all of the City's groundwater supplies to address the aforementioned water quality issues. The available yield from the project was determined to be 237 ac-ft/yr. This was the amount calculated to be necessary to meet the projected future demands for the City, once added to Clarksville's existing groundwater supplies. It is thus critical to note that consideration of this strategy is for the entire 620 ac-ft/yr of supply necessary to meet the City's projected demands. The planning process strictly considers the amount of supply necessary to meet the projected shortage, i.e., 237 ac-ft/yr, and uses this amount as the basis for cost estimation purposes. Nevertheless, the strategy would be for the

development of sufficient groundwater sources to meet the full 620 ac-ft/yr of projected City demands. It has been assumed for this strategy that existing groundwater wells of the City's are maintained.

Additional assumptions for this analysis included assuming Total Dissolved Solids (TDS) of 1,275 mg/L, and that two Reverse Osmosis (RO), Level 4 treatment plants would be located at the end of a 5-mile, 8-inch transmission line sized sufficiently to carry the full flow of pre-treated water, since when brackish water is treated, approximately 20% of the supply is lost as concentrate. An average of nearby depth (650 ft.) and head (250 ft.) of wells was utilized to calculate the potential number of wells needed (six new wells). For an assumed distance between wells of 1,500 ft., a total length of 7,500 ft. of 6-in. diameter well field piping was estimated. For the pipeline, 30 psi was assumed for the residual head at the end of the pipe, with a maximum pipeline pressure of 150 psi. Difference in elevation was assumed to be 50 ft. The treatment facilities would be of sufficient size (0.7 mgd) to treat the entirety of Clarksville's groundwater supply, both existing and proposed wells.

The TWDB's Unified Costing Model (UCM) was used to develop costs for this strategy. The total capital cost of the project is calculated to be approximately $10,537,000, with an annual cost of $1,598,000, for a unit cost during debt service of $2,577 per ac-ft ($7.91 per 1,000 gallons). After debt service, the unit cost would be approximately $1,382 per ac-ft.

**Contract with Lamar County WSD and Treated Water Pipeline to Detroit** - A strategy requested by the City of Clarksville is the construction of a 16" diameter pipeline from Clarksville to Detroit, and the purchase of up to 2 MGD of treated water from the Lamar County WSD. This strategy would be contingent upon the Lamar County WSD purchase of equivalent supply from the City of Paris. Cost estimates are based upon the TWDB's Unified Costing Model (UCM). The project is estimated to provide 303 ac-ft/yr by constructing a pipeline to Detroit, whereby the City of Clarksville would enter into a contract with the Lamar County WSD (contingent upon the District contracting for available supply from the City of Paris). This amount provides the surface water supply necessary for mixing with the City's existing groundwater supply, for a total project cost of $12.3 million, an annual cost of $1.5 million, and a unit cost for the additional supply of $5,010 per ac-ft. during debt service and $2,165 per ac-ft after debt service. Identifying uses for the additional production capability of the pipeline (up to 2 MGD) would likely lower the unit cost for this strategy.

***Contract with Texarkana and Treated Water Pipeline to De Kalb*** – Another strategy previously requested by the City of Clarksville is the construction of a 16" diameter pipeline from Clarksville to De Kalb, and the purchase of up to 2 MGD of treated water from Texarkana. This project is based on a cost estimate developed by Riverbend Water Resources District, along with a similar project cost estimate from MTG Engineers. The total cost, annual cost, and unit cost of water from the project has been estimated based upon the results of these studies, as entered into the TWDB's Unified Costing Model (UCM). The project is estimated to have a total yield of 2,240 ac-ft/yr of supply by constructing a pipeline to De Kalb, whereby the City of Clarksville would enter into a contract with the City of Texarkana (or alternatively Riverbend Water Resources District) for up to 593 ac-ft/yr (0.53 MGD). The amount necessary to meet Clarksville's projected needs is 303 ac-ft/yr (0.27 MGD). This amount provides the surface water supply necessary for mixing with the City's existing groundwater supply, for a total project cost of $11.7 million, an annual cost of $1.2 million, and a unit cost for the additional supply of $3,865 per ac-ft. during debt service and $1,149 per ac-ft after debt service. Identifying uses for the additional production capability of the pipeline (up to 2 MGD) would likely lower the unit cost for this strategy.

Concerns about this strategy are with regard to present issues entailing the supply of Wright Patman Reservoir to Texarkana and the remaining Member Cities of Riverbend Water Resources District. Concerns regarding the priority of a new contract for Clarksville for treated water supply from Texarkana/Riverbend are somewhat ameliorated due to the fact that in times of drought, Texarkana's 2012 Water Conservation & Drought Contingency Plan specifies that curtailment of water deliveries to wholesale customers will be done by a pro-rata method as provided in Texas Water Code, §11.039. Furthermore, the amounts of supply considered within the 2021 North East Texas Regional Water Plan are based upon firm yields developed employing the TCEQ Water Availability Model, and reflect legal and infrastructure constraints to identify the amount of available supply. It is expected that costs associated with this strategy would be negotiated between the City of Clarksville and Texarkana/Riverbend WRD, as the City of Clarksville has expressed a

potential interest in entering into a water supply relationship as a partner with these entities. This strategy, if implemented, would be contingent upon water management strategies identified for Riverbend WRD and its Member Entities.

***Dredge Langford Lake*** – The firm yield of Langford Lake decreases over time due to sedimentation in the reservoir reducing the total volume of conservation capacity. This strategy would entail the dredging of sediment from Langford Lake to restore storage capacity within the reservoir which has been lost due to this sedimentation. This project utilizes a 24" dredge to remove an estimated 3,000 ac-ft of sediment over a one-year calendar period. The unit cost of reservoir dredging, in units of dollars per ac-ft of sediment removed, has been calculated based upon a formula from the World Bank, as presented in the TWDB Report *Dredging vs. New Reservoirs* (2004). The resultant calculated cost was entered into the UCM to determine the debt service cost. The project is estimated to yield 520 ac-ft of firm supply by dredging an estimated total of 3,000 ac-ft of sediment from Langford Lake over one year, for a total project cost of $36.2 million, an annual cost of $2.8 million, and a unit cost of $5,398 per ac-ft. during debt service and $0 per ac-ft after debt service.

Concerns with this strategy include the location and impacts from disposition of dredged material, the efficiency of removal of the dredged material, and the potential need to repeat the effort in the future since dredging does not remove the source of sedimentation issues in the contributing watershed. As noted in TWDB (2005), issues with regard to dredging fall into four general categories: removal of the sediment, transportation, disposal, and re-use.

For the removal of sediment, dredging reservoirs, particularly at the shallow headwaters and reservoir margins can destroy habitats and affect wetland birds, etc. If the water sustains flora or fauna of particular value, or if fish issues are important, then issues exist regarding lowering the water level. Dredging may also result in a temporary loss of reservoir water quality, through removal of organic material, although there may be long-term improvements in the reservoir water quality through removal of such organic material. Downstream water quality may also be temporarily impacted due to dredging. There may also be a loss of land for containment areas to drain/treat the sediment.

Regarding transportation, reservoirs are often in remote areas. The impact of additional transportation during dredging can place pressure on local communities (e.g., noise/air pollution and physical damage to roads), although these impacts may be reduced if the sediment can be effectively dewatered at or near the reservoir site using, for example, a hydrocyclone and/or a filter bed press. The viability of disposal to land depends on the level of contaminants, whereby there may be risks to groundwater supplies from contamination by leaching.

Opportunities for the re-use of dredged material include sand/gravel/bricks for the construction industry, fertilizer, usage for filling abandoned quarry areas or mines, and usage for capping landfill sites.

***Dimple Reservoir*** – The City has also identified a feasible strategy to meet future water supply needs as being the construction of a new 28,541 ac-ft reservoir with a projected surface are of 2,230 acres on White Oak Bayou, a tributary of Pecan Bayou, to be utilized as an interbasin transfer from the Red River Basin to the Sulphur River Basin. This reservoir project was originally described in a 1986 report from HDR to the Red River Authority and project participants, entitled *Preliminary Engineering Report for Proposed Dimple Reservoir Project on White Oak Bayou*. The 1986 report identified a potential project site, reservoir area capacity, drainage area, and estimated construction costs for the reservoir and intake structure without equipment. Intake structure equipment and water pipelines from the reservoir were not included in the report, nor was a cost estimate. This site is described in Section 8.9.5 of the 2021 Region D Plan, although it has not been recommended as a unique reservoir site by the NETRWPG for the present round of regional planning.

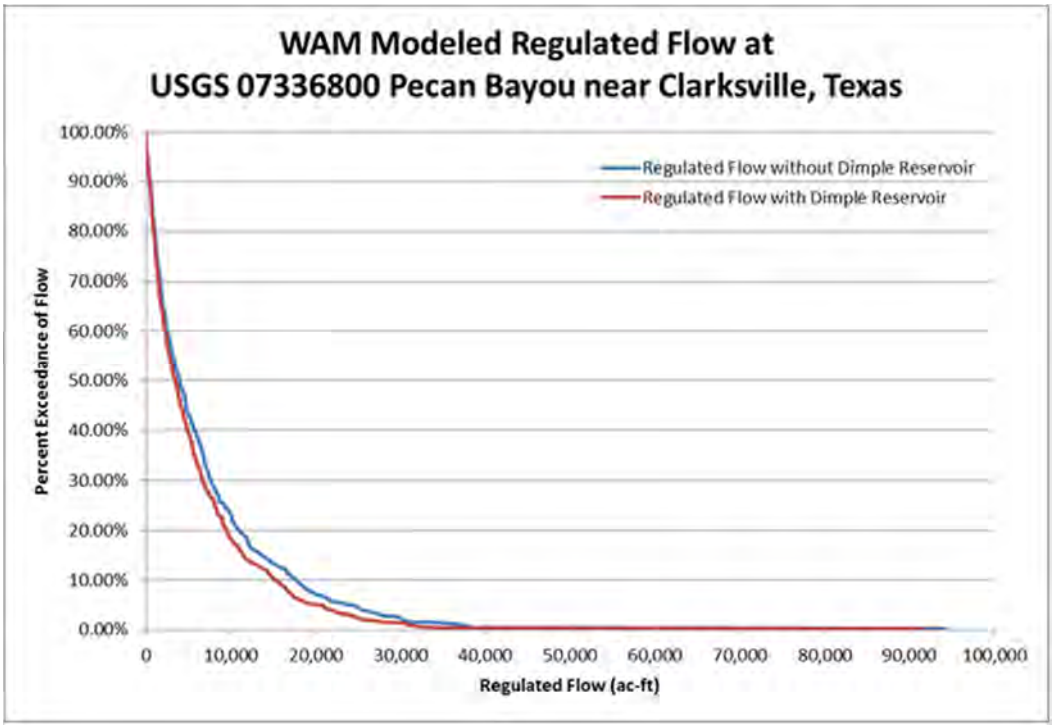
The reservoir construction costs from the 1986 report have been adjusted to September 2018 costs using the ENR Construction Cost Index (CCI) and entered into the UCM. Intake equipment and a raw water pipeline from the reservoir to the City of Clarksville's water treatment plant have also been preliminarily identified and included in the UCM. The raw water pipeline in the UCM is modeled to deliver the estimated firm yield with a peaking factor of 2. The project pipeline is 8" diameter, and approximately 8 miles long, following

existing roadways with an elevation increase of 40 feet. The pipeline costing utilizes the UCM's assumption of 15 psi for the residual head at End of Pipe for raw water and assumes a maximum pipeline pressure of 250 psi. UCM calculations for pump and power requirements provide the cost estimate for the intake equipment. For the 2021 planning process, the reservoir has been modeled in the Red River WAM (Run 3), subject to consensus environmental criteria at a junior priority date, and modeled considering the full demand of existing water rights in the Red River Basin. The results of this WAM analysis indicate the project has a firm yield of 10,200 ac-ft per year, although Clarksville needs only 303 ac-ft/yr to have adequate supply to mix with the City's groundwater supplies to meet its projected needs beyond 2020. However, the City intends to use up to 593 ac-ft/yr to meet its full projected demands. This strategy includes constructing a new 28,541 ac-ft reservoir and 8" pipeline to Clarksville's WTP, for a total project cost of $38.5 million with an annual cost of $2.4 million and a unit cost for the needed supply of $7,970 per ac-ft. with debt service and $1,099 per ac-ft without debt service. It should be noted, however, that Dimple Reservoir, as envisioned herein, is based on existing studies (from 1986) and characterizations of the impoundment. Studies investigating alternative configurations, perhaps using a smaller footprint, are encouraged. Furthermore, needs from additional entities, if identified as willing participants to such an effort, could improve the unit costs calculated for Clarksville herein.

Concerns with this strategy include the potential need for obtaining a surface water permit for an interbasin transfer from the Red River Basin to the Sulphur River Basin. However, there is the potential that this could be waived given the project is located within the same county as the proposed use. The Texas Water Code §11.085 identifies factors to be considered in the applicable regional water plans to address the following:

(A) the availability of feasible and practicable alternative supplies in the receiving basin to the water proposed for transfer;
(B) the amount and purposes of use in the receiving basin for which water is needed;
(C) proposed methods and efforts by the receiving basin to avoid waste and implement water conservation and drought contingency measures;
(D) proposed methods and efforts by the receiving basin to put the water proposed for transfer to beneficial use;
(E) the projected economic impact that is reasonably expected to occur in each basin as a result of the transfer; and
(F) the projected impacts of the proposed transfer that are reasonably expected to occur on existing water rights, instream uses, water quality, aquatic and riparian habitat, and bays and estuaries that must be assessed under Sections 11.147, 11.150, and 11.152 of this code in each basin. If the water sought to be transferred is currently authorized to be used under an existing permit, certified filing, or certificate of adjudication, such impacts shall only be considered in relation to that portion of the permit, certified filing, or certificate of adjudication proposed for transfer and shall be based on historical uses of the permit, certified filing, or certificate of adjudication for which amendment is sought;

The other alternatives considered herein present available alternatives in the receiving basin to the water proposed for transfer. The water would be used for municipal purposes. The City maintains its Water Conservation and Drought Contingency Plan, implementing measures identified therein to avoid waste and conserve water during times of drought. Minimal economic impact is expected in the Red River Basin, whereas positive economic benefits may occur by maintaining the City's municipal supply. As noted above, minimal impacts are expected on existing water rights, as the WAM has been utilized to maintain priorities of these water rights. There exists significant concern with regard to potential environmental impacts of the proposed reservoir considering that the reservoir's contributing watershed represents approximately 25% of the watershed contributing to Pecan Bayou, a stream segment conditionally recognized in the 2021 Region D Plan and by the Texas Parks and Wildlife Department as being an ecologically unique stream segment in the North East Texas Region. Presented below is a monthly flow frequency chart depicting the variation in flows in Pecan Bayou for with- and without project conditions. Significant impacts to agricultural and natural resources would also be expected within the footprint of the reservoir as well. Furthermore, mitigation and compensation may be necessary to the basin of origin.



Flow Frequency Distribution of Regulated Flows at USGS Gage #07336800, Pecan Bayou near Clarksville, Texas, with- and without Dimple Reservoir.

**Alternatives:**

| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Dimple Reservoir (ac-ft/yr)** | | | 303 | 303 | 303 | 303 |
| **Drill Additional Wells and RO Treatment (ac-ft/yr)** | | | 388 | 388 | 388 | 388 |
| **Detroit Pipeline (ac-ft/yr)** | | | 303 | 303 | 303 | 303 |

At present, considerable uncertainty exists in each of the identified feasible water management strategies for the City of Clarksville. The NETRWPG supports any efforts by the City of Clarksville to further study all potential strategies to identify the best approach for the City to meeting all of its future water supply needs, and such a study should be considered consistent with the 2021 North East Texas Regional Water Plan.

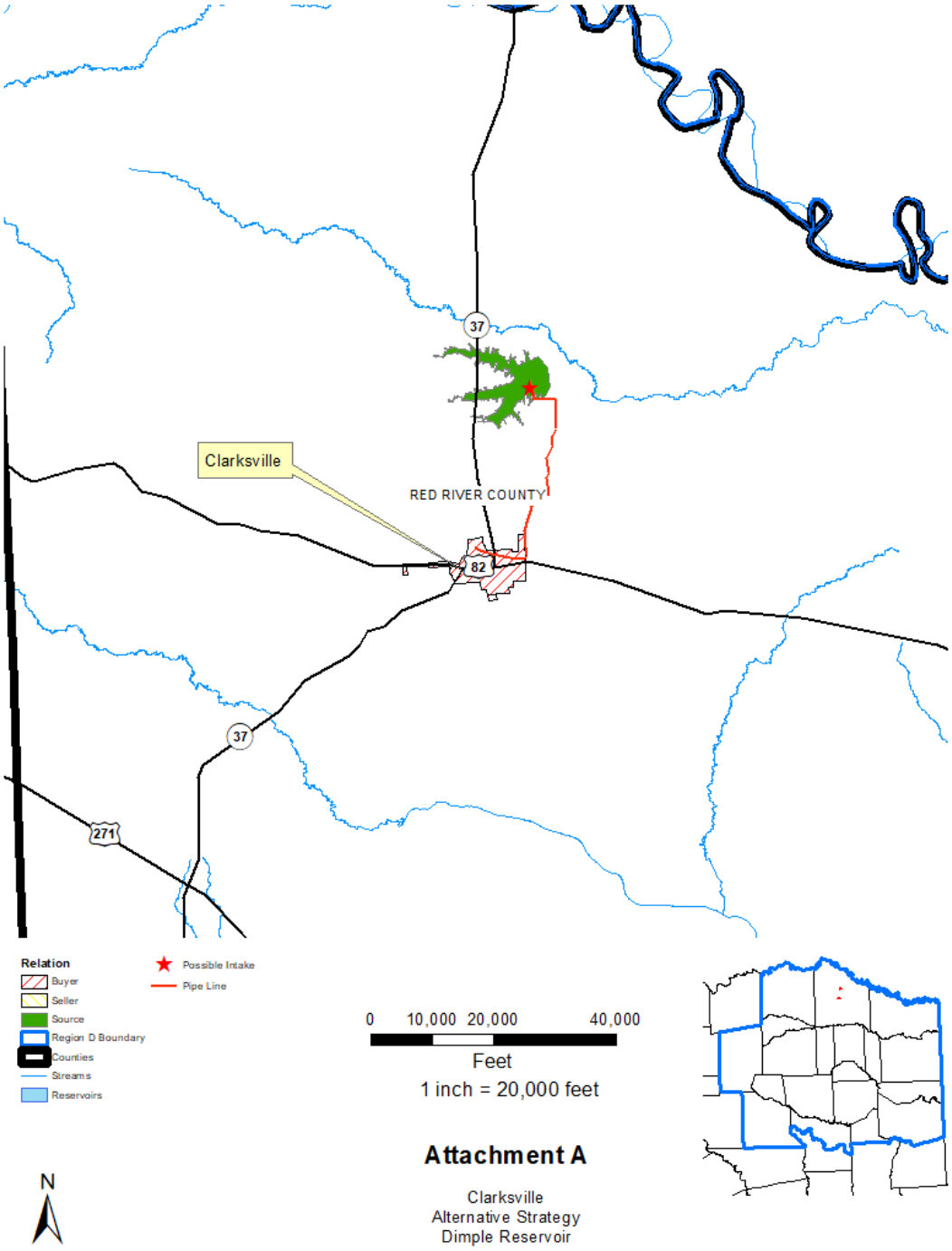
Should development of a Treated Water Pipeline to the City of Texarkana/Riverbend's system in DeKalb and contract to provide up to 303 ac-ft (ac-ft/yr) be determined to not be cost feasible, the City will need alternative strategies. To meet the City's projected deficit in 2040, identified alternative strategies for water supply include the study and development one of the following options*:

- Construct and develop Dimple Reservoir to provide a maximum 10,200 ac-ft/yr. To meet the City's projected deficit in 2040 an identified alternative strategy is for the City of Clarksville to pursue the development of Dimple Reservoir to meet the City's projected deficit in 2040. This project has the capability to meet the City's identified needs, as well as developing a supply to be potentially utilized by other demands in the area.
- Retire Langford Lake and development of a new well field and associated RO treatment facilities.
- Contract with the Lamar County WSD for supply from the City of Paris, which includes the development of a Treated Water Pipeline tying into Lamar County WSD's system in Detroit, Texas, to provide 303 ac-ft/yr for the projected needs of the City of Clarksville, although the City of Clarksville has indicated their intent, if this strategy is implemented, to contract additional supply as necessary to meet their full projected demands. This strategy allows for the resumption of the

City's utilization of existing groundwater supplies via mixing. This strategy is contingent upon the Lamar County WSD contracting for the necessary additional supply from the City of Paris.

*Assuming that water from the Sulphur River is not available from an upper region reservoir.

Given Clarksville's geographic location, it will be necessary that Clarksville establish working relationships with the City of Texarkana, Riverbend Water Resources District, the Sulphur River Basin Authority and/or the Red River Basin Authority to develop any new reservoir and/or water supply strategy.




**Attachment A**

Clarksville
Alternative Strategy
Dimple Reservoir

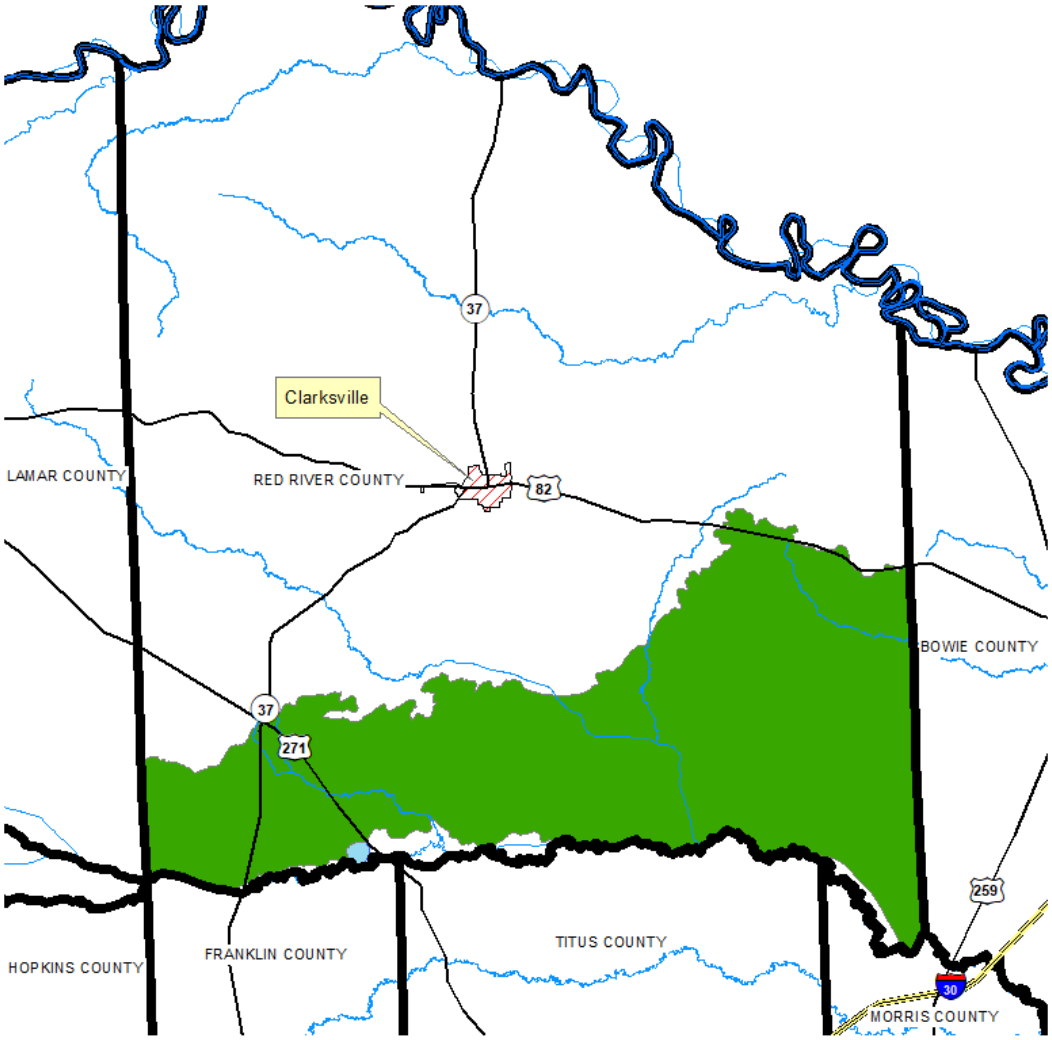
***Cost Estimate Summary***
***Water Supply Project Option***
***September 2018 Prices***

***Clarksville - Dimple Reservoir***

***Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018***

| *Item* | *Estimated Costs for Facilities* |
|---|---|
| Dam and Reservoir (Conservation Pool 28541 acft, 2130 acres) | $12,915,000 |
| Primary Pump Station (0 MGD) | $3,212,000 |
| Transmission Pipeline (0 in dia., miles) | $1,941,000 |
| Integration, Relocations, & Other | $3,558,000 |
| **TOTAL COST OF FACILITIES** | **$21,626,000** |
| Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities) | $5,681,000 |
| Environmental & Archaeology Studies and Mitigation | $5,151,000 |
| Land Acquisition and Surveying (2154 acres) | $4,999,000 |
| Interest During Construction (3% for 1 years with a 0.5% ROI) | $1,032,000 |
| **TOTAL COST OF PROJECT** | **$38,489,000** |
| **ANNUAL COST** | |
| Debt Service (3.5 percent, 20 years) | $836,000 |
| Reservoir Debt Service (3.5 percent, 40 years) | $1,246,000 |
| Operation and Maintenance | |
| Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities) | $55,000 |
| Intakes and Pump Stations (2.5% of Cost of Facilities) | $80,000 |
| Dam and Reservoir (1.5% of Cost of Facilities) | $194,000 |
| Water Treatment Plant | $0 |
| Advanced Water Treatment Facility | $0 |
| Pumping Energy Costs (50990 kW-hr @ 0.08 $/kW-hr) | $4,000 |
| Purchase of Water ( acft/yr @ $/acft) | $0 |
| **TOTAL ANNUAL COST** | **$2,415,000** |
| **Available Project Yield (acft/yr)** | 303 |
| **Annual Cost of Water ($ per acft), based on PF=2** | $7,970 |
| **Annual Cost of Water After Debt Service ($ per acft), based on PF=2** | $1,099 |
| **Annual Cost of Water ($ per 1,000 gallons), based on PF=2** | $24.46 |
| **Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=2** | $3.37 |

*Note: One or more cost element has been calculated externally*




**Attachment B**

Clarksville
Alternative Strategy
Drill New Wells (Red River, Nacatoch, Sulphur)

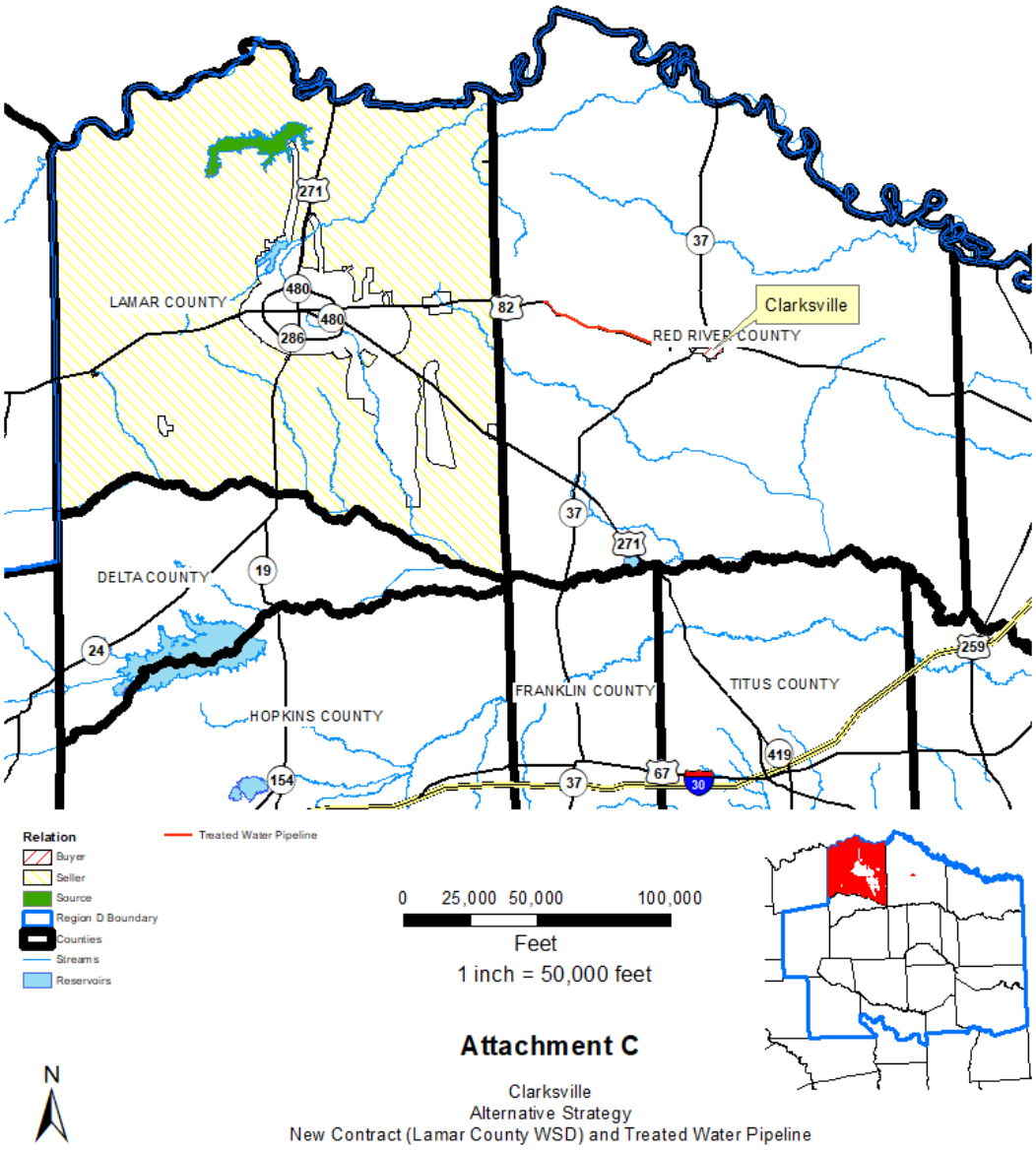
***Cost Estimate Summary***
***Water Supply Project Option***
***September 2018 Prices***

***Clarksville - Drill New Wells (Red River, Nacatoch Aquifer, Red Basin) and RO Treatment***

***Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018***

| *Item* | *Estimated Costs for Facilities* |
|---|---|
| Well Fields (Wells, Pumps, and Piping) | $1,917,000 |
| Water Treatment Plant (0.7 MGD) | $3,590,000 |
| **TOTAL COST OF FACILITIES** | **$7,421,000** |
| | |
| Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities) | $2,545,000 |
| Environmental & Archaeology Studies and Mitigation | $208,000 |
| Land Acquisition and Surveying (25 acres) | $80,000 |
| Interest During Construction (3% for 1 years with a 0.5% ROI) | $283,000 |
| **TOTAL COST OF PROJECT** | **$10,537,000** |
| | |
| **ANNUAL COST** | |
| Debt Service (3.5 percent, 20 years) | $741,000 |
| Operation and Maintenance | |
| Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities) | $30,000 |
| Intakes and Pump Stations (2.5% of Cost of Facilities) | $22,000 |
| Dam and Reservoir (1.5% of Cost of Facilities) | $0 |
| Water Treatment Plant | $670,000 |
| Advanced Water Treatment Facility | $0 |
| Pumping Energy Costs (202540 kW-hr @ 0.08 $/kW-hr) | $16,000 |
| Purchase of Water (388 acft/yr @ 500 $/acft) | $194,000 |
| **TOTAL ANNUAL COST** | **$1,673,000** |
| | |
| **Available Project Yield (acft/yr)** | 388 |
| **Annual Cost of Water ($ per acft), based on PF=2** | $4,312 |
| **Annual Cost of Water After Debt Service ($ per acft), based on PF=2** | $2,402 |
| **Annual Cost of Water ($ per 1,000 gallons), based on PF=2** | $13.23 |
| **Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=2** | $7.37 |

*JMP* *9/30/2019*




## Attachment C

Clarksville
Alternative Strategy
New Contract (Lamar County WSD) and Treated Water Pipeline

***Cost Estimate Summary***
***Water Supply Project Option***
***September 2018 Prices***

***Clarksville - New Contract with Lamar County WSD and pipeline to Detroit***

***Cost based on ENR CCI 11170.28 for September 2018 and***
***a PPI of 201.9 for September 2018***

| *Item* | *Estimated Costs for Facilities* |
|---|---|
| Primary Pump Station (0 MGD) | $1,088,000 |
| Transmission Pipeline (0 in dia., miles) | $7,693,000 |
| **TOTAL COST OF FACILITIES** | **$8,781,000** |
| Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities) | $2,689,000 |
| Environmental & Archaeology Studies and Mitigation | $340,000 |
| Land Acquisition and Surveying (37 acres) | $117,000 |
| Interest During Construction (3% for 1 years with a 0.5% ROI) | $328,000 |
| **TOTAL COST OF PROJECT** | **$12,255,000** |
| **ANNUAL COST** | |
| Debt Service (3.5 percent, 20 years) | $862,000 |
| Operation and Maintenance | |
| Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities) | $77,000 |
| Intakes and Pump Stations (2.5% of Cost of Facilities) | $27,000 |
| Dam and Reservoir (1.5% of Cost of Facilities) | $0 |
| Water Treatment Plant | $0 |
| Advanced Water Treatment Facility | $0 |
| Pumping Energy Costs (727701 kW-hr @ 0.08 $/kW-hr) | $58,000 |
| Purchase of Water (303 acft/yr @ 1629.14 $/acft) | $494,000 |
| **TOTAL ANNUAL COST** | **$1,518,000** |
| **Available Project Yield (acft/yr)** | 303 |
| **Annual Cost of Water ($ per acft), based on PF=1** | $5,010 |
| **Annual Cost of Water After Debt Service ($ per acft), based on PF=1** | $2,165 |
| **Annual Cost of Water ($ per 1,000 gallons), based on PF=1** | $15.37 |
| **Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1** | $6.64 |

*JMP* *10/5/2019*

## EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF IRRIGATION IN RED RIVER COUNTY

**Description of Water User Group:**

The Irrigation WUG in Red River County has a demand that is projected to decrease from 5,156 ac-ft/yr in 2020 to 4,895 ac-ft/yr in 2070. Irrigation in Red River County is projected to be supplied by existing surface water from run-of-river diversions from the Red and Sulphur Rivers. A deficit of 4,376 ac-ft/yr is projected to occur in 2020 and decrease to 4,125 ac-ft/yr by 2070.

**Water Supply and Demand Analysis:**

| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Projected Water Demand** | 3,867 | 3,867 | 3,867 | 3,867 | 3,867 | 3,867 |
| **Current Water Supply** | 2,523 | 2,523 | 2,523 | 2,523 | 2,523 | 2,523 |
| **Projected Supply Surplus (+)/Deficit(-)** | **-1,344** | **-1,344** | **-1,344** | **-1,344** | **-1,344** | **-1,344** |

| **Projected Supply Surplus (+)/Deficit(-) by Basin** | **2020** | **2030** | **2040** | **2050** | **2060** | **2070** |
|---|---|---|---|---|---|---|
| **Sulphur** | -2,154 | -2,154 | -2,154 | -2,154 | -2,154 | -2,154 |
| **Red** | 810 | 810 | 810 | 810 | 810 | 810 |
| **Total** | **-1,344** | **-1,344** | **-1,344** | **-1,344** | **-1,344** | **-1,344** |

**Evaluation of Potentially Feasible Water Management Strategies:**

Multiple alternative strategies were considered to meet the Red River County Irrigation WUG's water supply shortages. Advanced water conservation for irrigation practices were not considered in this planning effort, as amounts potentially saved would not provide sufficient savings to meet the projected needs over the planning period. The use of reuse water from nearby municipalities is not considered feasible as it would not be effective to deliver reuse water to farm irrigation systems.

Groundwater was identified as a potential source of water for irrigation in Red River County. A local hydrogeologic assessment was performed by Region D to assess source groundwater availability, as there is no GCD located within the Region. Based on a relatively low average annual water level decline and the potential for high-productivity wells in the portion of the Nacatoch Aquifer located in the Sulphur River Basin in Red River County, it has been determined that the future projected needs can likely be met with additional irrigation wells. For the portion of the Trinity Aquifer located in the Sulphur River Basin in Red River County, the local hydrogeologic assessment did not identify sufficient available data to determine potential productivity; however, since there is little to no current production from this portion of the Trinity Aquifer, it has been determined that sufficient source availability is likely to meet the projected needs identified for the Irrigation WUG in Red River County.

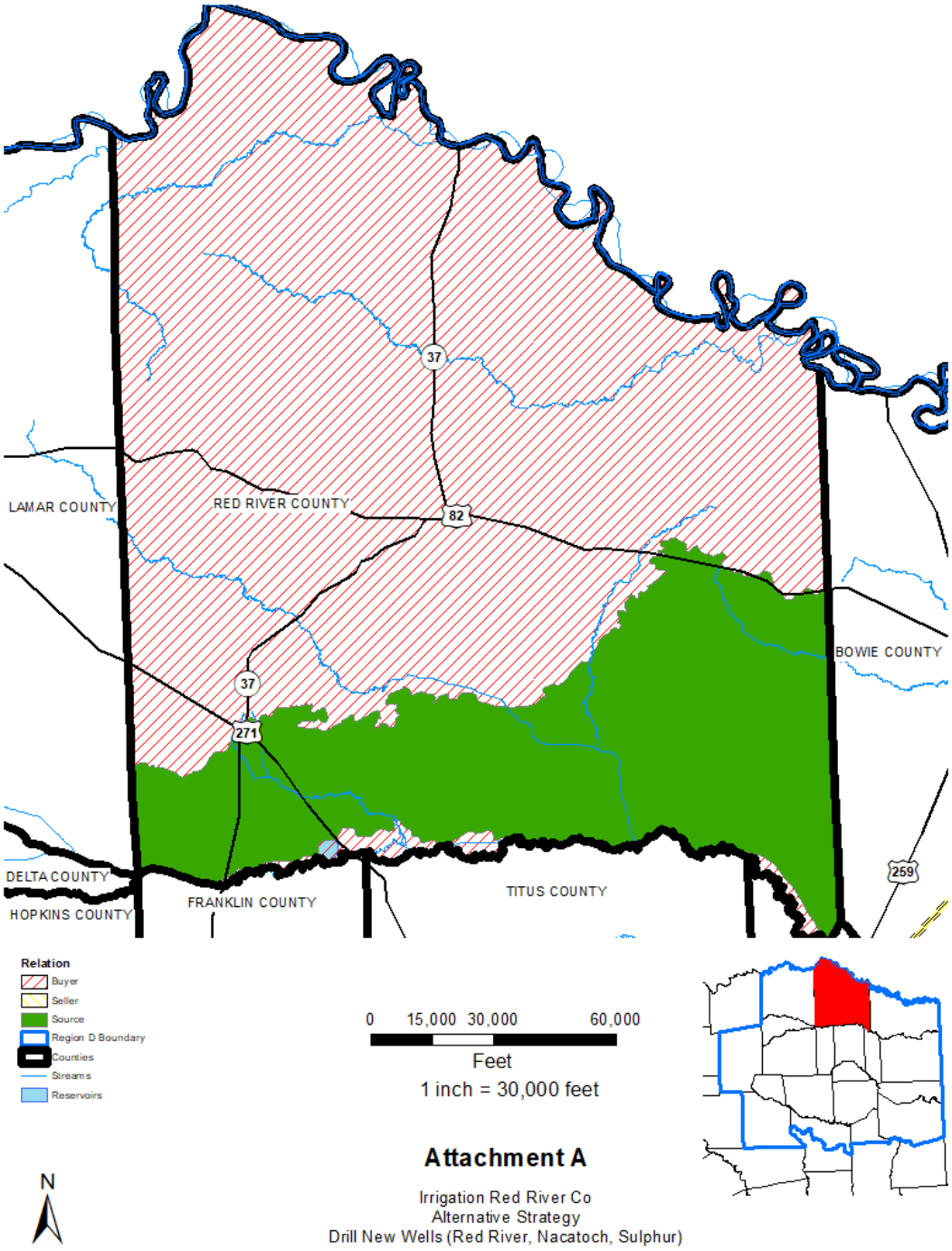
Treated surface water purchased from Lamar County WSD was considered as a viable supplement to the additional groundwater in order to meet projected demands. Purchasing sufficient treated surface water from Lamar County WSD to meet the entirety of the need was also considered as possible strategy. Purchasing raw water from the City of Paris has also been considered as a possible strategy, with a higher capital cost but an anticipated lower annual cost. The City's surface water permit for Pat Mayse Reservoir, as amended, allows for the interbasin transfer and use of water in both the Red and Sulphur River basins. However, the use of water via this permit would require a minor amendment to add irrigation as a permitted use.

| Strategy | Firm Yield (AF) | Total Capital Cost | Total Annualized Cost | Unit Cost | Env. Impact |
|---|---|---|---|---|---|
| Advanced Water Conservation | | | | | |
| Water Reuse | | | | | |
| Drill New Wells (Blossom Aquifer, Red Basin) | | | | | |
| Drill New Wells (Nacatoch Aquifer, Red Basin) | | | | | |
| Drill New Wells, (Nacatoch Aquifer, Sulphur Basin) | **2,057** | **$6,551,000** | **$1,709,000** | **$831** | **1** |
| Drill New Wells (Trinity Aquifer, Red Basin) | | | | | |
| Drill New Wells (Trinity Aquifer, Sulphur Basin) | **97** | **$425,000** | **$88,000** | **$907** | **1** |
| Pat Mayse Treated Water Pipeline from Lamar County WSD | **2,154** | **$23,769,000** | **$5,619,000** | **$2,609** | **2** |
| Pat Mayse Raw Water Pipeline from Paris | **2,154** | **$45,682,000** | **$4,535,000** | **$2,105** | **2** |

**Identified Alternative WMS and WMSP:**

| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Drill New Well (Trinity Aquifer, Sulphur Basin)** | **97** | **97** | **97** | **97** | **97** | **97** |

The identified alternative water management strategy for the Red River County Irrigation WUG to meet projected demands during the planning period is in addition to the recommended strategy, to drill one new well in the Trinity Aquifer, Sulphur Basin, Red River County, to meet the remaining unmet need of 97 ac-ft/yr due to MAG limitations. The Region D analysis indicates that the 97 ac-ft/yr of need remaining after implementation of recommended strategies can be obtained from existing sources exceeding the MAG from the Trinity Aquifer, Sulphur Basin with one additional well rated at 75 gpm. This alternative strategy represents the more likely scenario for the WUG given the lack of a Groundwater Conservation District within the NETRWPA.




## Attachment A

Irrigation Red River Co
Alternative Strategy
Drill New Wells (Red River, Nacatoch, Sulphur)

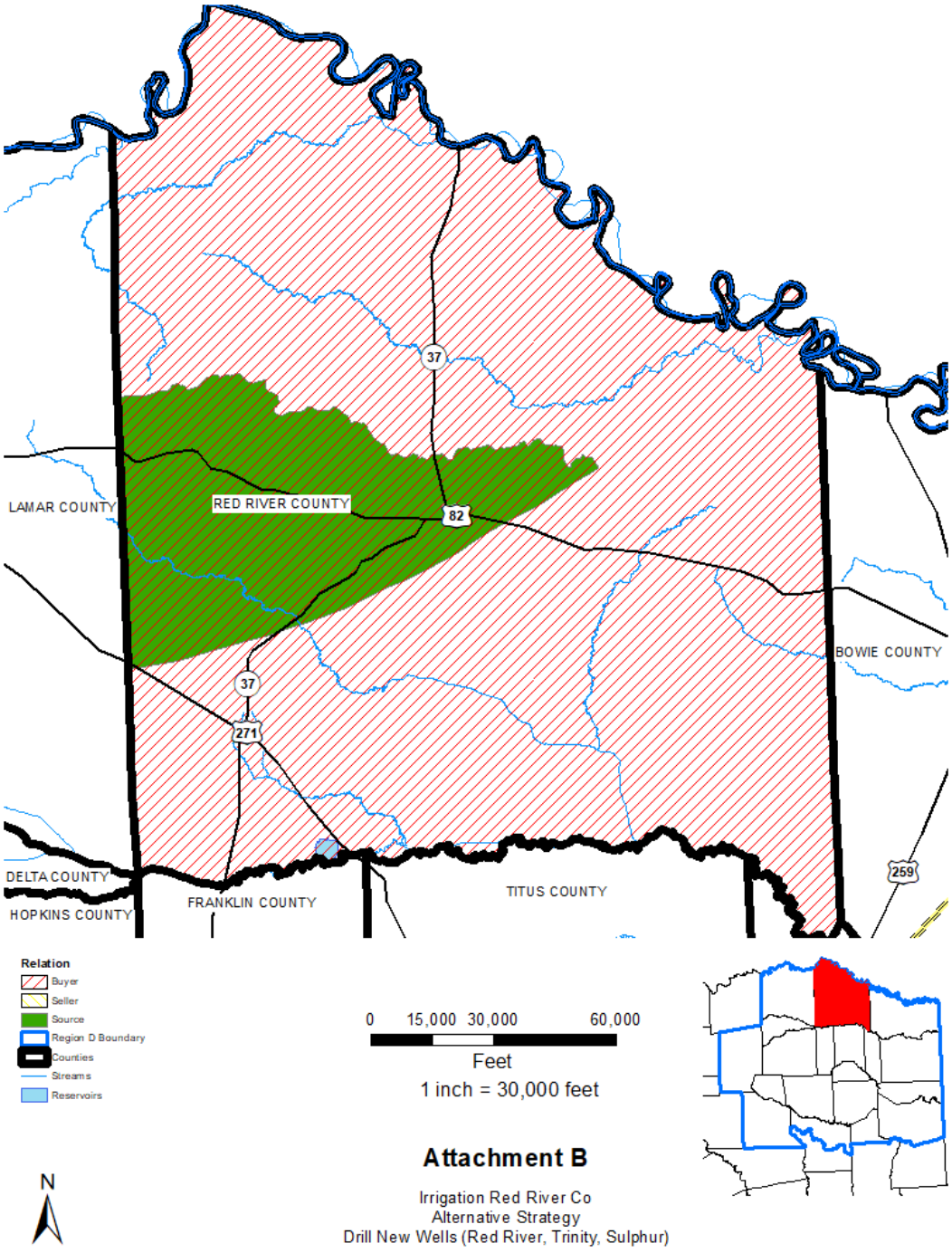
***Cost Estimate Summary***
***Water Supply Project Option***
***September 2018 Prices***

***Irrigation Red River - Drill New Wells (Red River, Nacatoch Aquifer, Sulphur Basin)***

***Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018***

| *Item* | *Estimated Costs for Facilities* |
|---|---|
| **CAPITAL COST** | |
| Well Fields (Wells, Pumps, and Piping) | $4,580,000 |
| **TOTAL COST OF FACILITIES** | **$4,580,000** |
| | |
| Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities) | $1,603,000 |
| Environmental & Archaeology Studies and Mitigation | $131,000 |
| Land Acquisition and Surveying (12 acres) | $61,000 |
| Interest During Construction (3% for 1 years with a 0.5% ROI) | $176,000 |
| **TOTAL COST OF PROJECT** | **$6,551,000** |
| | |
| **ANNUAL COST** | |
| Debt Service (3.5 percent, 20 years) | $461,000 |
| Reservoir Debt Service (3.5 percent, 40 years) | $0 |
| Operation and Maintenance | |
| Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities) | $46,000 |
| Intakes and Pump Stations (2.5% of Cost of Facilities) | $0 |
| Dam and Reservoir (1.5% of Cost of Facilities) | $0 |
| Water Treatment Plant | $0 |
| Advanced Water Treatment Facility | $0 |
| Pumping Energy Costs (2158148 kW-hr @ 0.08 $/kW-hr) | $173,000 |
| Purchase of Water (2057 acft/yr @ 500 $/acft) | $1,029,000 |
| **TOTAL ANNUAL COST** | **$1,709,000** |
| | |
| **Available Project Yield (acft/yr)** | 2,057 |
| **Annual Cost of Water ($ per acft), based on PF=1** | $831 |
| **Annual Cost of Water After Debt Service ($ per acft), based on PF=1** | $607 |
| **Annual Cost of Water ($ per 1,000 gallons), based on PF=1** | $2.55 |
| **Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1** | $1.86 |

*JMP* *10/5/2019*




## Attachment B

Irrigation Red River Co
Alternative Strategy
Drill New Wells (Red River, Trinity, Sulphur)

***Cost Estimate Summary***
***Water Supply Project Option***
***September 2018 Prices***

***Irrigation Red River - Drill New Wells (Red River, Trinity Aquifer, Sulphur Basin)***

***Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018***

| *Item* | *Estimated Costs for Facilities* |
|---|---|
| Well Fields (Wells, Pumps, and Piping) | $298,000 |
| **TOTAL COST OF FACILITIES** | **$298,000** |
| | |
| Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities) | $104,000 |
| Environmental & Archaeology Studies and Mitigation | $8,000 |
| Land Acquisition and Surveying (1 acres) | $3,000 |
| Interest During Construction (3% for 1 years with a 0.5% ROI) | $12,000 |
| **TOTAL COST OF PROJECT** | **$425,000** |
| | |
| **ANNUAL COST** | |
| Debt Service (3.5 percent, 20 years) | $30,000 |
| Operation and Maintenance | |
| Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities) | $3,000 |
| Intakes and Pump Stations (2.5% of Cost of Facilities) | $0 |
| Dam and Reservoir (1.5% of Cost of Facilities) | $0 |
| Water Treatment Plant | $0 |
| Advanced Water Treatment Facility | $0 |
| Pumping Energy Costs (77268 kW-hr @ 0.08 $/kW-hr) | $6,000 |
| Purchase of Water (97 acft/yr @ 500 $/acft) | $49,000 |
| **TOTAL ANNUAL COST** | **$88,000** |
| | |
| **Available Project Yield (acft/yr)** | 97 |
| **Annual Cost of Water ($ per acft), based on PF=1** | $907 |
| **Annual Cost of Water After Debt Service ($ per acft), based on PF=1** | $598 |
| **Annual Cost of Water ($ per 1,000 gallons), based on PF=1** | $2.78 |
| **Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1** | $1.83 |

*JMP* *10/5/2019*

REGION D
EVALUATIONS OF ALTERNATIVE WATER MANAGEMENT STRATEGIES
FOR MEETING PROJECTED WATER SUPPLY NEEDS
TO YEAR 2070

# VAN ZANDT COUNTY

*WUGs:*

The City of Canton
Van Zandt County Manufacturing

## EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF CITY OF CANTON

**Description of Water User Group:**

The City of Canton provides water service in Van Zandt County. The city's population is projected to be 3,963 by 2020 and increasing to 5,329 by 2070. The City of Canton utilizes groundwater from the Carrizo-Wilcox aquifer, and surface water from Mill Creek Reservoir and a run of river water right for water supplies. The City of Canton is not projected to have a shortage during the planning period.

**Water Supply and Demand Analysis:**

| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Population** | 3,963 | 4,333 | 4,616 | 4,897 | 5,130 | 5,329 |
| **Projected Water Demand** | 961 | 1,032 | 1,085 | 1,143 | 1,196 | 1,242 |
| **Water Demand from other entities** | 0 | 0 | 0 | 0 | 0 | 0 |
| **Current Water Supply** | 1,544 | 1,544 | 1,544 | 1,544 | 1,544 | 1,544 |
| **Projected Supply Surplus (+) / Deficit (-)** | **583** | **512** | **459** | **401** | **327** | **281** |

| **Projected Supply Surplus (+) / Deficit (-) by Basin** | **2020** | **2030** | **2040** | **2050** | **2060** | **2070** |
|---|---|---|---|---|---|---|
| **Sabine** | 583 | 512 | 459 | 401 | 327 | 281 |
| **Trinity** | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total** | **583** | **512** | **459** | **401** | **327** | **281** |

**Evaluation of Potentially Feasible Water Management Strategies:**

In 2008, the Canton City council authorized the appropriation of $70,000 to prepare a long-term water plan. The project evaluated four (4) reservoir sites in Van Zandt County. Two of the four proved to be feasible from a technical standpoint. The City spent an additional $30,000 in 2009 and 2010 to address questions and provide additional information requested by the committee members. In addition to these two long-term strategies, two additional water wells were included to satisfy short-term needs. These two additional wells have been completed. Additional groundwater supply is a potentially feasible strategy. Water reuse is a potentially feasible water supply strategy, as the City currently has a water rights application pending at the Texas Commission on Environmental Quality for the authorization of indirect reuse. At the request of the City of Canton, the construction of an additional water well by 2020 was identified as a feasible strategy because the City of Canton is planning on developing additional groundwater supply to supplement existing supplies. Also at the request of the City, a potential new reservoir on Grand Saline Creek was also considered as a feasible strategy for the City.

| Strategy | Firm Yield (ac-ft) | Total Capital Cost | Total Annualized Cost | Unit Cost | Environmental Impact |
|---|---|---|---|---|---|
| Advanced Water Conservation | | | | | |
| Indirect/Direct Reuse | **256** | **$6,234,000** | **$604,000** | **$2,359** | **1** |
| Drill New Well (Carrizo-Wilcox, Sabine Basin) | **100** | **$716,000** | **$142,000** | **$1,420** | **1** |
| New Reservoir on Grand Saline Creek | **1,810** | **$62,966,000** | **$3,896,000** | **$2,152** | **5** |

***New Reservoir on Grand Saline Creek*** – The City has identified a feasible strategy to meet future water supply needs as being the construction of a new 1,845 acre (24,980 ac-ft) reservoir on Grand Saline Creek, a tributary of Sabine River. This reservoir project was originally described in a 2008 report from Gary Burton Engineering, Inc. to the City of Canton, entitled *Long-Term Water Study Surface Water Supply.*

The 2008 report identified the project site, reservoir surface area, drainage area, and estimated construction costs for the reservoir, intake structure, transmission pipeline and water treatment plant expansion.

The construction costs associated with the new reservoir, raw water transmission line, and water treatment plant expansion are based on calculations from the UCM. For the 2016 planning process, the reservoir has been modeled in the Sabine River WAM (Run 3), subject to SB 3 environmental flow criteria at a junior priority date, and modeled considering the full demand of existing water rights in the Sabine River Basin. The results of this WAM analysis indicate the project has a firm yield of 1,810 ac-ft per year. The project is estimated to yield 1,810 ac-ft/yr of supply by constructing a new 24,980 ac-ft reservoir and 14" pipeline to Canton's WTP and expanding the WTP, for a total project cost of $63 million with an annual cost of $3.9 million and a unit cost for the additional supply of $2,152 per ac-ft. with debt service and $265 per ac-ft without debt service.

**Identified Alternative WMS and WMSP:**

| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **New Reservoir on Grand Saline Creek (ac-ft/yr)** | 1,810 | 1,810 | 1,810 | 1,810 | 1,810 | 1,810 |

Because of substantial disagreement over future population and water demands, the City has requested the following alternate strategy:

> The strategy to meet future needs "is with surface water from a proposed reservoir on Grand Saline Creek. The City of Canton has provided to NETRWPG resolutions from three other cities in Van Zandt County supporting the reservoir project. This show of support indicates that a regional surface water reservoir could possibly replace the groundwater strategies for other Van Zandt County public water supplies with projected deficits. However, due to the time typically required to obtain the necessary permits to impound surface water, the City plans to construct one or two additional wells, or implement a reuse option in the interim to meet increasing demands due to population growth and the First Monday influence." This alternative wording should be considered consistent with this plan in the event that population growth in the potential service area significantly exceeds current NETRWPG projections.

This alternative strategy for the City of Canton is to construct by 2020 a new 1,845 acre (24,980 ac-ft) reservoir on Grand Saline Creek, a tributary of Sabine River, construct a 14" pipeline from the new reservoir's intake to Canton's WTP and expanding the WTP. The project is estimated to yield 1,810 ac-ft/yr of supply.

***Cost Estimate Summary***
***Water Supply Project Option***
***September 2018 Prices***

***Canton - New Reservoir on Grand Saline Creek***

***Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018***

| *Item* | *Estimated Costs for Facilities* |
|---|---|
| **CAPITAL COST** | |
| Dam and Reservoir (Conservation Pool 24980 acft, 1845 acres) | $10,713,000 |
| Transmission Pipeline (14 in dia., 11.9 miles) | $5,174,000 |
| Intake Pump Stations (3.2 MGD) | $6,440,000 |
| Transmission Pump Station(s) & Storage Tank(s) | $2,493,000 |
| **TOTAL COST OF FACILITIES** | **$24,820,000** |
| Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities) | $8,428,000 |
| Environmental & Archaeology Studies and Mitigation | $18,601,000 |
| Land Acquisition and Surveying (1884 acres) | $9,431,000 |
| Interest During Construction (3% for 1 years with a 0.5% ROI) | $1,686,000 |
| **TOTAL COST OF PROJECT** | **$62,966,000** |
| **ANNUAL COST** | |
| Debt Service (3.5 percent, 20 years) | $1,398,000 |
| Reservoir Debt Service (3.5 percent, 40 years) | $2,018,000 |
| Operation and Maintenance | |
| Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities) | $62,000 |
| Intakes and Pump Stations (2.5% of Cost of Facilities) | $198,000 |
| Dam and Reservoir (1.5% of Cost of Facilities) | $161,000 |
| Water Treatment Plant | $0 |
| Advanced Water Treamtent Facility | $0 |
| Pumping Energy Costs (733645 kW-hr @ 0.08 $/kW-hr) | $59,000 |
| Purchase of Water ( acft/yr @ $/acft) | $0 |
| **TOTAL ANNUAL COST** | **$3,896,000** |
| **Available Project Yield (acft/yr)** | 1,810 |
| **Annual Cost of Water ($ per acft), based on PF=2** | $2,152 |
| **Annual Cost of Water After Debt Service ($ per acft), based on PF=2** | $265 |
| **Annual Cost of Water ($ per 1,000 gallons), based on PF=2** | $6.60 |

| | |
|---|---|
| **Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=2** | $0.81 |
| *JMP* | *10/17/2019* |

## EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF MANUFACTURING IN VAN ZANDT COUNTY

**Description of Water User Group:**

The Manufacturing WUG in Van Zandt County has a demand that is projected to increase from 506 ac-ft/yr in 2020 to 757 ac-ft/yr by 2030, remaining constant through 2070. Manufacturing in Van Zandt County is supplied by groundwater from the Carrizo-Wilcox Aquifer, purchased groundwater from Golden WSC and Grand Saline, and surface water from run-of-river permits on the Sabine River, a permit for diversion from Lake Tawakoni. A deficit of 208 ac-ft/yr is projected to occur in 2030, decreasing to 116 ac-ft/yr by 2070.

**Water Supply and Demand Analysis:**

| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Projected Water Demand** | 506 | 757 | 757 | 757 | 757 | 757 |
| **Current Water Supply** | 264 | 264 | 264 | 264 | 253 | 253 |
| **Projected Supply Surplus (+)/Deficit(-)** | **-242** | **-493** | **-493** | **-493** | **-504** | **-504** |

| **Projected Supply Surplus (+)/Deficit(-) by Basin** | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Sabine** | -242 | -492 | -492 | -492 | -503 | -503 |
| **Trinity** | 0 | -1 | -1 | -1 | -1 | -1 |
| **Total** | **-242** | **-493** | **-493** | **-493** | **-504** | **-504** |

**Evaluation of Potentially Feasible Water Management Strategies:**

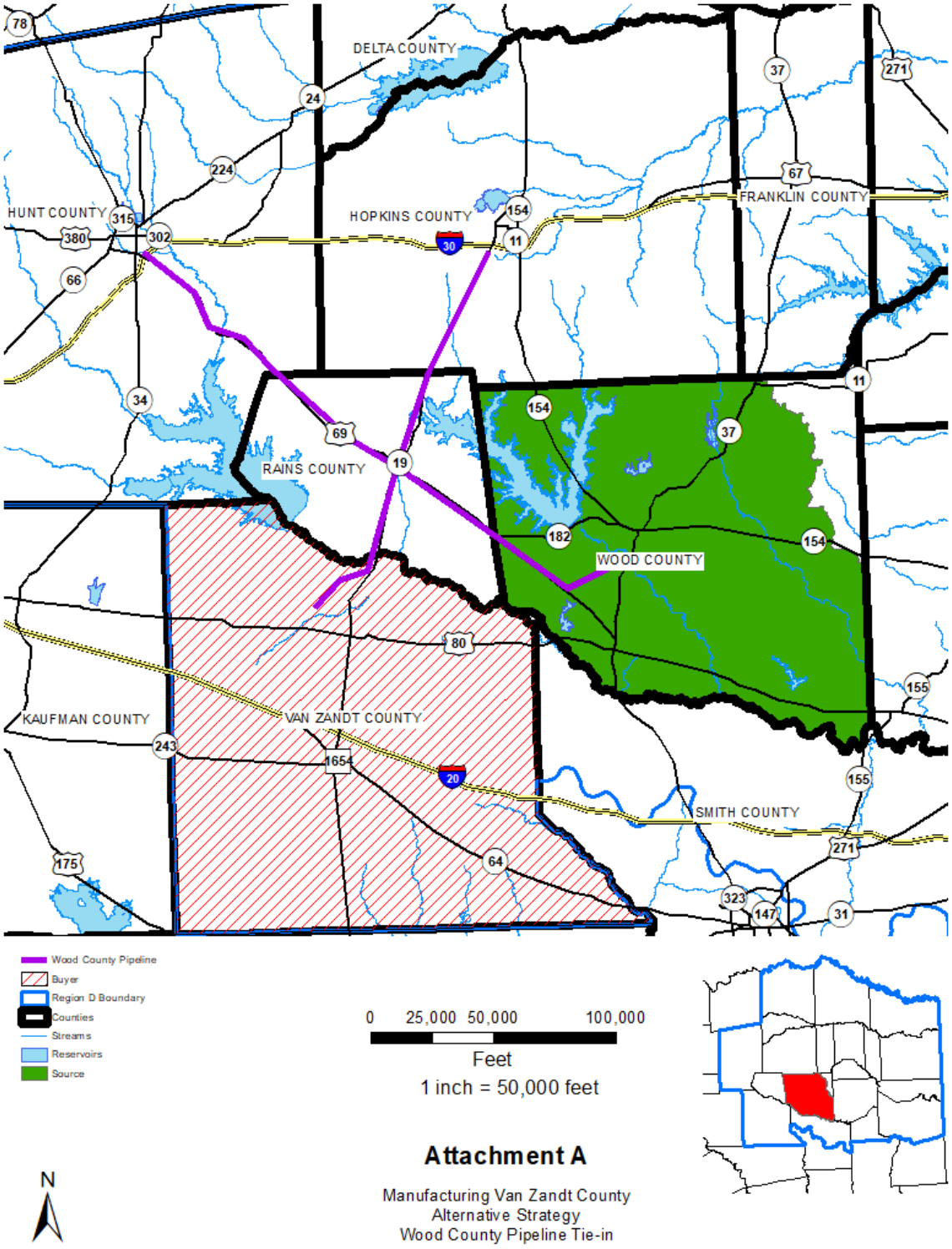
Eight alternative strategies were considered to meet the Van Zandt County Manufacturing WUG's water supply shortages. Advanced water conservation for manufacturing was considered in this planning effort to reduce overall demands; however, it does not resolve all identified needs. The use of reuse water from nearby municipalities was not considered to be feasible at present. Surface water was not considered as a viable alternative to meet projected demands because no supplies are readily available in the proximity of the identified needs. Groundwater has been identified as a potential source of water for manufacturing in Van Zandt County. In addition, groundwater supplies can be contracted from the City of Grand Saline and Golden WSC. Another potentially feasible strategy is the Wood County Pipeline which could supply groundwater from Wood County.

| Strategy | Firm Yield (AF) | Total Capital Cost | Total Annualized Cost | Unit Cost | Environmental Impact |
|---|---|---|---|---|---|
| Advanced Water Conservation | **75** | **$0** | **$0** | **$0** | **1** |
| Water Reuse | | | | | |
| Drill New Wells (Carrizo-Wilcox Aquifer; Trinity Basin) | **504** | **$2,852,000** | **$506,000** | **$1,004** | **1** |
| Drill New Wells (Carrizo-Wilcox Aquifer; Sabine Basin) | **1** | **$292,000** | **$24,000** | **$24,000** | **1** |
| Increase Existing Contract for Carrizo-Wilcox from Grand Saline | **72** | **$0** | **$202,000** | **$2,806** | **1** |
| Increase Existing Contract for Carrizo-Wilcox from Golden WSC | **214** | **$0** | **$279,000** | **$1,304** | **1** |
| Wood County Pipeline Tie-in | **429** | **$0** | **$619,000** | **$1,442** | **2** |

**Identified Alternative WMS and WMSP:**

| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Advanced Water Conservation** | 0 | 75 | 75 | 75 | 75 | 75 |
| **Wood County Pipeline Tie-in** | 242 | 418 | 418 | 418 | 429 | 429 |

The identified Alternative Water Management Strategy for the Manufacturing WUG in Van Zandt County is the Wood County Pipeline Strategy, of which an Alternative Water Management Strategy Project is the acquisition of raw water from the Van Zandt County Branch of the Wood County Pipeline Strategy. For the purposes of the 2021 Plan, costs associated with the Van Zandt County Branch are included in the overall costs of the WMS. That portion of the capital and annual costs associated to the Van Zandt County Branch are included in the annual purchase cost for this WMSP. No additional costs were assumed for distribution of the raw water beyond the assumed end of the Van Zandt County Branch. This alternative strategy is contingent upon the regionalized development of a groundwater well field in Wood County and a conveyance pipeline from Wood County to Van Zandt County.




## Attachment A

Manufacturing Van Zandt County
Alternative Strategy
Wood County Pipeline Tie-in

***Cost Estimate Summary***
***Water Supply Project Option***
***September 2018 Prices***

***Manufacturing Van Zandt - Wood County Pipeline Tie-in***

***Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018***

| *Item* | *Estimated Costs for Facilities* |
|---|---|
| **ANNUAL COST** | |
| Operation and Maintenance | |
| Intakes and Pump Stations (2.5% of Cost of Facilities) | $0 |
| Dam and Reservoir (1.5% of Cost of Facilities) | $0 |
| Water Treatment Plant | $0 |
| Advanced Water Treatment Facility | $0 |
| Pumping Energy Costs (0 kW-hr @ 0.08 $/kW-hr) | $0 |
| Purchase of Water (429 acft/yr @ 1442 $/acft) | $619,000 |
| **TOTAL ANNUAL COST** | **$619,000** |
| **Available Project Yield (acft/yr)** | 429 |
| **Annual Cost of Water ($ per acft), based on PF=1** | $1,443 |
| **Annual Cost of Water After Debt Service ($ per acft), based on PF=1** | $1,443 |
| **Annual Cost of Water ($ per 1,000 gallons), based on PF=1** | $4.43 |
| **Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1** | $4.43 |

*JMP* *10/6/2019*

REGION D
EVALUATIONS OF ALTERNATIVE WATER MANAGEMENT STRATEGIES
FOR MEETING PROJECTED WATER SUPPLY NEEDS
TO YEAR 2070

# WOOD COUNTY

*WUGs:*

Wood County Livestock
Wood County Manufacturing
Wood County Pipeline Regionalization Strategy

## EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS LIVESTOCK IN WOOD COUNTY

**Description of Water User Group:**

The Livestock WUG in Wood County is a split entity and has a demand that is projected to be a constant 483 ac-ft/yr from 2020 to 2070. Livestock in Wood County, Cypress has a current water supply consisting of water wells from the Carrizo-Wilcox Aquifer and Local Supplies. The total rated available supply from these sources is 449 ac-ft/yr in 2020 thru 2070. Livestock in Wood County, Cypress is projected to have a water supply deficit of 34 ac-ft/yr in 2020 thru 2070.

The Livestock WUG in Wood County Sabine is a split entity and has a demand that is projected to be a constant 2,741 ac-ft/yr from 2020 to 2070. Livestock in Wood County Sabine has a current water supply consisting of water wells from the Carrizo-Wilcox Aquifer and Local Supplies. The total rated available supply from these sources is 1,643 ac-ft/yr in 2020 thru 2070. Livestock in Wood County, Sabine is projected to have a water supply deficit of 1,098 ac-ft/yr in 2020 thru 2070.

**Water Supply and Demand Analysis:**

| **Livestock Wood Cypress** | **2020** | **2030** | **2040** | **2050** | **2060** | **2070** |
|---|---|---|---|---|---|---|
| **Projected Water Demand** | 483 | 483 | 483 | 483 | 483 | 483 |
| **Current Water Supply** | 555 | 555 | 555 | 555 | 555 | 555 |
| **Projected Supply Surplus (+)/Deficit(-)** | 72 | 72 | 72 | 72 | 72 | 72 |

| **Livestock Wood Sabine** | **2020** | **2030** | **2040** | **2050** | **2060** | **2070** |
|---|---|---|---|---|---|---|
| **Projected Water Demand** | 2,741 | 2,741 | 2,741 | 2,741 | 2,741 | 2,741 |
| **Current Water Supply** | 1,643 | 1,643 | 1,643 | 1,643 | 1,643 | 1,643 |
| **Projected Supply Surplus (+)/Deficit(-)** | -1,098 | -1,098 | -1,098 | -1,098 | -1,098 | -1,098 |

**Evaluation of Potentially Feasible Water Management Strategies:**

Six alternative strategies were considered to meet the Wood County, Livestock, Sabine water supply shortages as summarized in the following table. Advanced conservation, water reuse, and surface water alternatives were not considered because the livestock demands are very rural in nature. Groundwater from the Queen City Aquifer (Sabine River Basin) was identified as a potentially feasible strategy for the WUG. Groundwater from the Wood County Pipeline has also been identified as a potentially feasible strategy.

| **Strategy** | **Firm Yield (AF)** | **Total Capital Cost** | **Total Annualized Cost** | **Unit Cost** | **Environmental Impact** |
|---|---|---|---|---|---|
| Advanced Water Conservation | | | | | |
| Water Reuse | | | | | |
| Groundwater (Sabine) | **1,129** | **$ 1,210,000** | **$ 125,000** | **$ 111** | **1** |
| Surface Water | | | | | |
| Local Supply | | | | | |
| Wood County Pipeline Tie-in | **1,132** | **$2,479,000** | **$787,000** | **$695** | **2** |

**Identified Alternative WMS and WMSP:**

| | **2020** | **2030** | **2040** | **2050** | **2060** | **2070** |
|---|---|---|---|---|---|---|
| **Wood County Pipeline Tie-in** | 1,132 | 1,132 | 1,132 | 1,132 | 1,132 | 1,132 |

The identified Alternative Water Management Strategy for the Livestock WUG in Wood County to meet their projected deficit of 1,098 ac-ft/yr in 2020 thru 2070 is the Wood County Pipeline Strategy, of which an Alternative Water Management Strategy Project is to construct a tie-in pipeline into the Wood County Wellfield and transmission pipeline. This alternative WMSP assumes a 2 mile long 12” diameter pipeline with a reduced unit cost of water given the proximity of the demand to the source. This alternative strategy is contingent upon the regionalized development of a groundwater well field in Wood County.

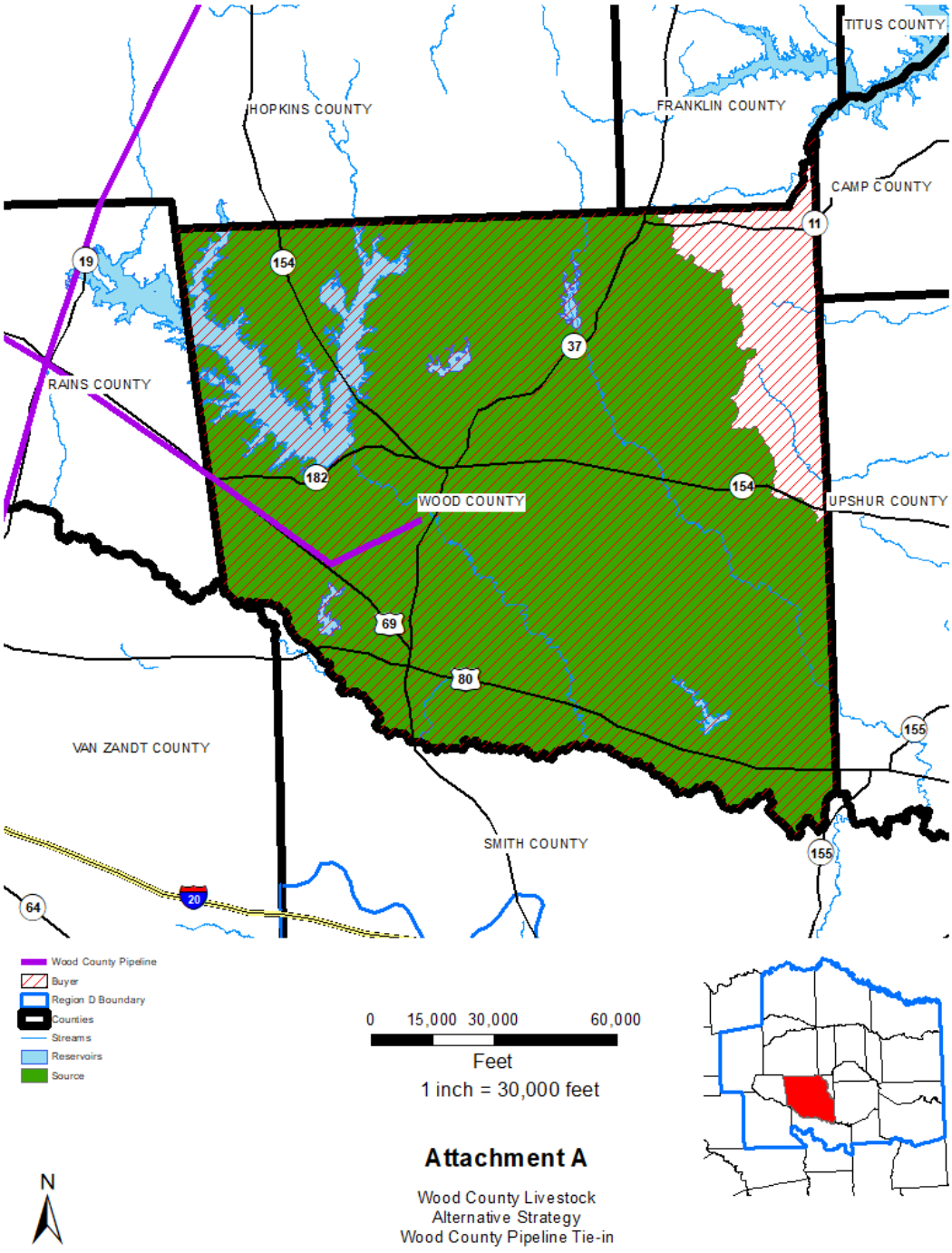
***Cost Estimate Summary***
***Water Supply Project Option***
***September 2018 Prices***

***Wood County Livestock - Wood County Pipeline Tie-in***

***Cost based on ENR CCI 11170.28 for September 2018 and***
***a PPI of 201.9 for September 2018***

| *Item* | *Estimated Costs for Facilities* |
|---|---|
| Primary Pump Station (0 MGD) | $999,000 |
| Transmission Pipeline (0 in dia., miles) | $719,000 |
| **TOTAL COST OF FACILITIES** | **$1,718,000** |
| | |
| Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities) | $565,000 |
| Environmental & Archaeology Studies and Mitigation | $75,000 |
| Land Acquisition and Surveying (10 acres) | $54,000 |
| Interest During Construction (3% for 1 years with a 0.5% ROI) | $67,000 |
| **TOTAL COST OF PROJECT** | **$2,479,000** |
| | |
| **ANNUAL COST** | |
| Debt Service (3.5 percent, 20 years) | $174,000 |
| Operation and Maintenance | |
| Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities) | $7,000 |
| Intakes and Pump Stations (2.5% of Cost of Facilities) | $25,000 |
| Dam and Reservoir (1.5% of Cost of Facilities) | $0 |
| Water Treatment Plant | $0 |
| Advanced Water Treamtent Facility | $0 |
| Pumping Energy Costs (182738 kW-hr @ 0.08 $/kW-hr) | $15,000 |
| Purchase of Water (1132 acft/yr @ 500 $/acft) | $566,000 |
| **TOTAL ANNUAL COST** | **$787,000** |
| | |
| **Available Project Yield (acft/yr)** | 1,132 |
| **Annual Cost of Water ($ per acft), based on PF=2** | $695 |
| **Annual Cost of Water After Debt Service ($ per acft), based on PF=2** | $542 |
| **Annual Cost of Water ($ per 1,000 gallons), based on PF=2** | $2.13 |
| **Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=2** | $1.66 |

*JMP* *10/6/2019*




**Attachment A**

Wood County Livestock
Alternative Strategy
Wood County Pipeline Tie-in

## EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS MANUFACTURING IN WOOD COUNTY

**Description of Water User Group:**

The Manufacturing WUG in Wood County has a demand that is projected to be increasing from 2,532 ac-ft/yr in 2020 to 3,085 ac-ft/yr in 2070. Manufacturing in Wood County has a current water supply from Carrizo-Wilcox Aquifer. The total rated available supply from this source is 1,502 ac-ft/yr. Manufacturing in Wood County is projected to have a water supply deficit of 1,030 ac-ft/yr in 2020 increasing to a deficit of 1,583 ac-ft/yr in 2070.

**Water Supply and Demand Analysis:**

| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Projected Water Demand** | 2532 | 2085 | 3085 | 3085 | 3085 | 3085 |
| **Current Water Supply** | 1502 | 1502 | 1502 | 1502 | 1502 | 1502 |
| **Projected Supply Surplus (+)/Deficit(-)** | **-1,030** | **-1,583** | **-1,583** | **-1,583** | **-1,583** | **-1,583** |

**Evaluation of Potentially Feasible Water Management Strategies:**

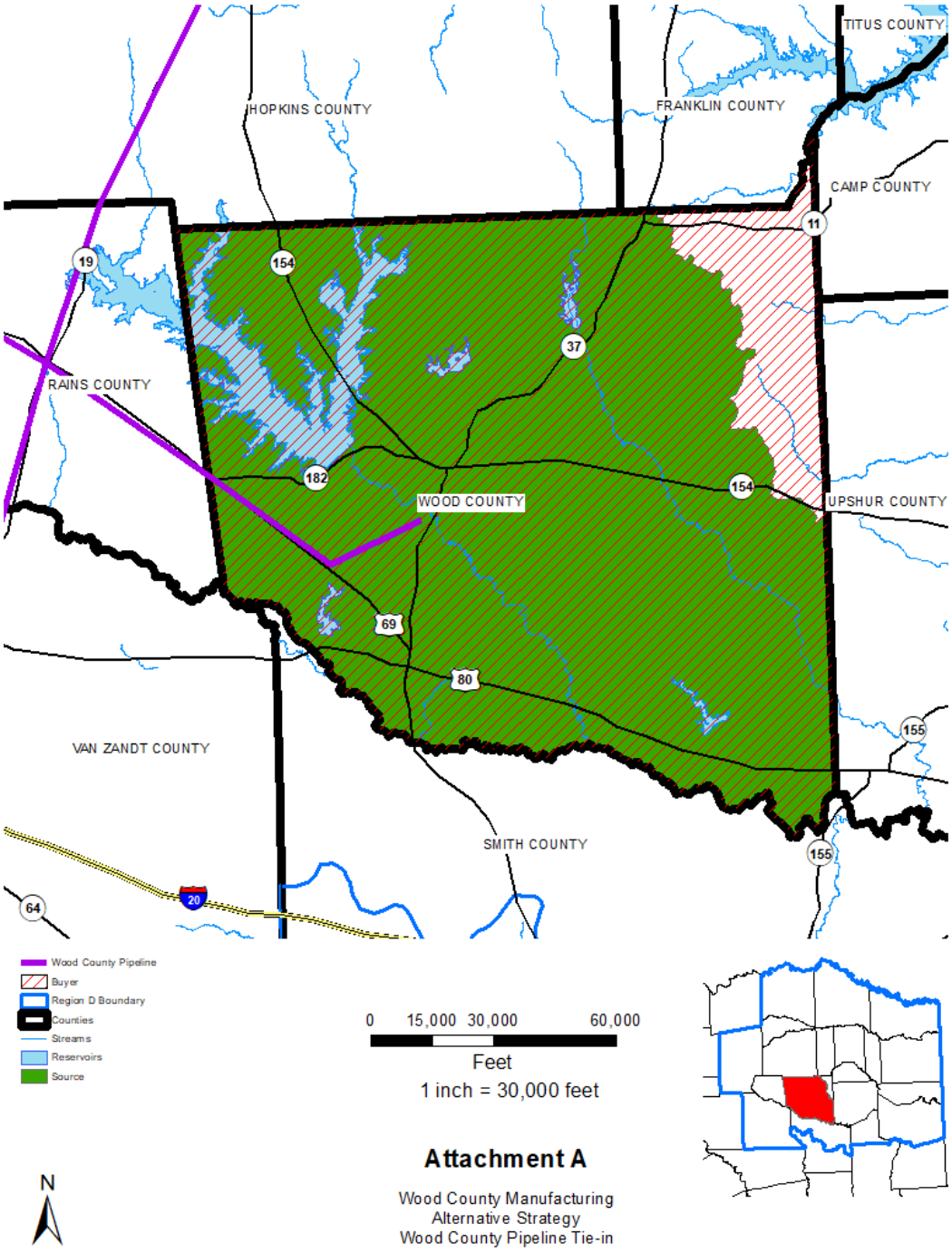
Five alternative strategies were considered to meet the Wood County Manufacturing water supply shortages as summarized in the following table. Advanced conservation and water reuse was not considered because operational procedures for the existing mines is not available. Surface water alternatives were omitted since there is not a supply source within close proximity to the county with available supply. Groundwater wells in the Queen City Aquifer (Sabine River Basin) were identified as a potentially feasible strategy for the WUG. Groundwater from the Wood County Pipeline has also been identified as a potentially feasible strategy.

| Strategy | Firm Yield (AF) | Total Capital Cost | Total Annualized Cost | Unit Cost | Environmental Impact |
|---|---|---|---|---|---|
| Advanced Water Conservation | | | | | |
| Water Reuse | | | | | |
| Groundwater (Queen City Aquifer, Sabine Basin) | **1,610** | **$ 1,210,000** | **$ 125,000** | **$ 78** | **1** |
| Surface Water | | | | | |
| Wood County Pipeline Tie-in | **1,583** | **$2,722,000** | **$1,038,000** | **$656** | **2** |

**Identified Alternative WMS and WMSP:**

| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Wood County Pipeline Tie-in** | 1,030 | 1,583 | 1,583 | 1,583 | 1,583 | 1,583 |

The identified Alternative Water Management Strategy for the Manufacturing WUG in Wood County to meet their projected deficit of 1,583 ac-ft/yr is the Wood County Pipeline Strategy, of which an Alternative Water Management Strategy Project is to construct a tie-in pipeline into the Wood County Wellfield and transmission pipeline. This alternative WMSP assumes a 2 mile long 14" diameter pipeline with a reduced unit cost of water given the proximity of the demand to the source. This alternative strategy is contingent upon the regionalized development of a groundwater well field in Wood County.




**Attachment A**

Wood County Manufacturing
Alternative Strategy
Wood County Pipeline Tie-in

***Cost Estimate Summary***
***Water Supply Project Option***
***September 2018 Prices***

***Wood County Manufacturing - Wood County Pipeline Tie-in***

***Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018***

| *Item* | *Estimated Costs for Facilities* |
|---|---|
| Primary Pump Station (0 MGD) | $1,029,000 |
| Transmission Pipeline (0 in dia., miles) | $870,000 |
| **TOTAL COST OF FACILITIES** | **$1,899,000** |
| | |
| Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities) | $621,000 |
| Environmental & Archaeology Studies and Mitigation | $75,000 |
| Land Acquisition and Surveying (10 acres) | $54,000 |
| Interest During Construction (3% for 1 years with a 0.5% ROI) | $73,000 |
| **TOTAL COST OF PROJECT** | **$2,722,000** |
| | |
| **ANNUAL COST** | |
| Debt Service (3.5 percent, 20 years) | $191,000 |
| Operation and Maintenance | |
| Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities) | $9,000 |
| Intakes and Pump Stations (2.5% of Cost of Facilities) | $26,000 |
| Dam and Reservoir (1.5% of Cost of Facilities) | $0 |
| Water Treatment Plant | $0 |
| Advanced Water Treamtent Facility | $0 |
| Pumping Energy Costs (251006 kW-hr @ 0.08 $/kW-hr) | $20,000 |
| Purchase of Water (1583 acft/yr @ 500 $/acft) | $792,000 |
| **TOTAL ANNUAL COST** | **$1,038,000** |
| | |
| **Available Project Yield (acft/yr)** | 1,583 |
| **Annual Cost of Water ($ per acft), based on PF=2** | $656 |
| **Annual Cost of Water After Debt Service ($ per acft), based on PF=2** | $535 |
| **Annual Cost of Water ($ per 1,000 gallons), based on PF=2** | $2.01 |
| **Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=2** | $1.64 |

*JMP* *10/6/2019*

## EVALUATION OF REGIONALIZATION STRATEGY WOOD COUNTY PIPELINE

**Description of Regional Strategy:**

An identified potentially feasible water management strategy representing a regionalization approach is the development and construction of a well field in Wood County and transmission pipelines from the well field to Greenville in Hunt County and tie-in pipelines to Hopkins and Van Zandt Counties, utilizing potentially available supply from the Carrizo-Wilcox Aquifer, Sabine River Basin. Preliminary analyses suggest approximately 35,000 ac-ft/yr of supply could be produced and used as a potential supply. The NETRWPG has identified a number of entities with projected needs over the 2020-2070 planning period that could feasibly utilize this supply

**WUG Water Need Analysis:**

| WUG | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| Brinker WSC | 0 | 0 | 0 | 12 | 47 | 83 |
| Cumby | 13 | 29 | 44 | 58 | 77 | 88 |
| Irrigation Hopkins County | 4,627 | 4,627 | 4,627 | 4,627 | 4,627 | 4,627 |
| Livestock Hopkins County | 1,068 | 1,090 | 1,140 | 1,143 | 1,196 | 1,219 |
| Martin Springs WSC | 0 | 0 | 0 | 0 | 0 | 29 |
| Miller Grove WSC | 8 | 16 | 23 | 29 | 40 | 52 |
| Mining Hopkins County | 227 | 283 | 360 | 444 | 533 | 639 |
| B H P WSC | 2 | 72 | 125 | 209 | 333 | 505 |
| Caddo Basin SUD | 7 | 220 | 406 | 722 | 1,202 | 1,866 |
| Caddo Mills (Via Greenville) | 0 | 1 | 36 | 68 | 108 | 254 |
| Cash SUD | 0 | 0 | 466 | 722 | 895 | 373 |
| Celeste | 29 | 52 | 86 | 136 | 209 | 316 |
| Hunt County-Other (Via Greenville) | 0 | 0 | 166 | 703 | 1,817 | 3,834 |
| Hickory Creek SUD (Via Greenville) | 96 | 273 | 519 | 866 | 1,366 | 2,095 |
| Mining Hunt County | 73 | 64 | 35 | 19 | 7 | 0 |
| North Hunt SUD | 89 | 165 | 266 | 405 | 603 | 888 |
| Poetry WSC | 0 | 66 | 115 | 200 | 330 | 510 |
| Wolfe City (Via Greenville) | 0 | 0 | 0 | 54 | 157 | 308 |
| Manufacturing Van Zandt County | 242 | 418 | 418 | 418 | 429 | 429 |
| Livestock Wood County | 1,132 | 1,132 | 1,132 | 1,132 | 1,132 | 1,132 |
| Manufacturing Wood County | 1,030 | 1,583 | 1,583 | 1,583 | 1,583 | 1,583 |
| Volume Passed Through Greenville | 96 | 274 | 721 | 1,691 | 3,448 | 6,491 |
| **Total Projected Need** | **8,643** | **10,091** | **11,547** | **13,550** | **16,691** | **20,830** |

| Projected Need by County | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| Hopkins | 5,943 | 6,045 | 6,194 | 6,313 | 6,520 | 6,737 |
| Hunt | 296 | 913 | 2,220 | 4,104 | 7,027 | 10,949 |
| Van Zandt | 242 | 418 | 418 | 418 | 429 | 429 |
| Wood | 2,162 | 2,715 | 2,715 | 2,715 | 2,715 | 2,715 |
| **Total** | **8,643** | **10,091** | **11,547** | **13,550** | **16,691** | **20,830** |

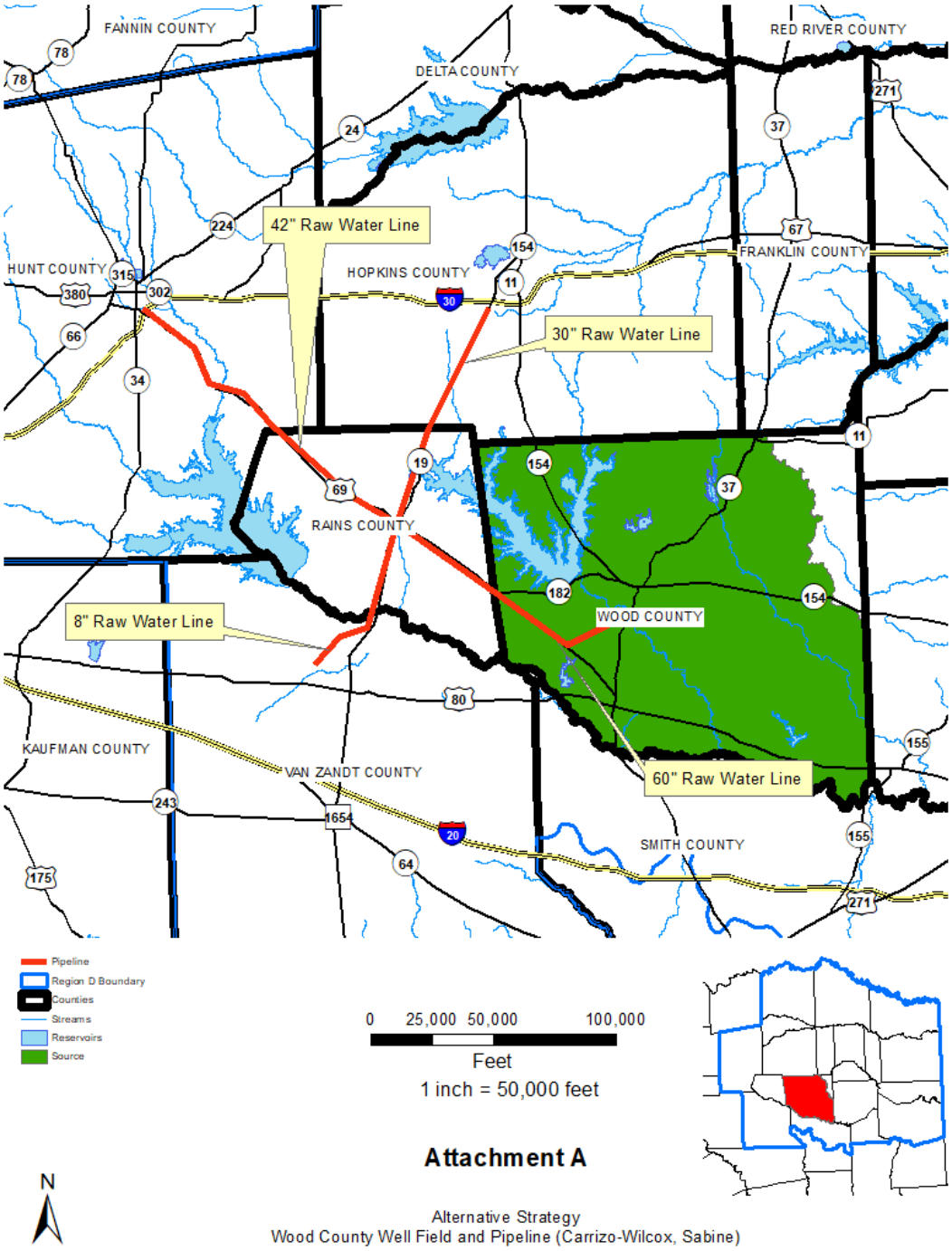
**Identified Alternative WMS:**

The Wood County Well Field could provide up to 20,830 ac-ft of water per year from the Carrizo-Wilcox Aquifer by an estimated total of 22 wells with peak production capacity of 1,800 gpm. A single well with a peak capacity of 1,800 gpm could provide up to 967 ac-ft per year of water per well, with four (4) contingency wells for a total of 26 wells. The Carrizo-Wilcox Aquifer in Wood County, in the Sabine River Basin, is projected to have sufficient supply availability to meet the needs of the identified WUGs for the planning period. Water from the well field would be pumped to a 610,000 gallon ground storage tank before being pumped to Greenville in Hunt County via a 60” diameter pipeline to Emory and a 42” diameter line to Greenville. At Emory, a 30” diameter tie-in delivers water to Hopkins County and an 8” tie-in delivers water to Van Zandt County. Individual customer WUGs then have Alternative WMS projects which are contingent upon this strategy to develop tie-in pipelines to the Wood County Well Field’s transmission pipeline.

Costs for the WMS have been developed at the planning level utilizing the TWDB's UCM. The project is estimated to yield 20,830 ac-ft/yr of supply to meet the current projected demands for the identified WUGs in Region D. The estimated total capital cost for the well field, collection lines, and major transmission lines to Hunt, Hopkins and Van Zandt Counties is approximately $228.3 million. The estimated annual cost is approximately $30 million, with a unit cost for the additional supply of $1,442 per ac-ft ($4.43/1,000 gal) with debt service, and $671 per ac-ft ($2.06/1,000 gal) without debt service.

| Strategy | Firm Yield (AF) | Total Capital Cost | Total Annualized Cost | Unit Cost | Env. Impact |
|---|---|---|---|---|---|
| Drill New Wells and Raw Water Pipeline (Carrizo-Wilcox, Sabine) | 20,830 | $228,312,000 | $30,040,000 | $1,442 | 2 |

Given significant present uncertainty regarding the extent of participation in this regional strategy and lack of details regarding the specific infrastructure necessary to meet actual participant water demands, it should be recognized that the strategy as represented herein is a planning-level characterization. Variations as to the specific users of this project, as well as variations in the characteristics of the project's infrastructure, should be considered consistent with this alternative water management strategy for the purposes of the 2021 Region D Plan. The NETRWPG supports additional study of this regionalization water management strategy, and such studies or technical evaluations should also be considered consistent for the purposes of the 2021 Region D Plan. Participation in this strategy would be on a voluntary basis.




**Attachment A**

Alternative Strategy
Wood County Well Field and Pipeline (Carrizo-Wilcox, Sabine)

***Cost Estimate Summary***
***Water Supply Project Option***
***September 2018 Prices***

***Wood Co. Wellfield WMS - Wood Co. Wellfield***

***Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018***

| *Item* | *Estimated Costs for Facilities* |
|---|---|
| **CAPITAL COST** | |
| Transmission Pipeline (60 in dia., 47.2 miles) | $84,308,000 |
| Primary Pump Stations (37.2 MGD) | $23,962,000 |
| Transmission Pipeline (0 in dia., 31.7 miles) | $21,697,000 |
| Well Fields (Wells, Pumps, and Piping) | $32,650,000 |
| Storage Tanks (Other Than at Booster Pump Stations) | $3,537,000 |
| **TOTAL COST OF FACILITIES** | **$166,154,000** |
| Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities) | $52,854,000 |
| Environmental & Archaeology Studies and Mitigation | $2,389,000 |
| Land Acquisition and Surveying (156 acres) | $804,000 |
| Interest During Construction (3% for 1 years with a 0.5% ROI) | $6,111,000 |
| **TOTAL COST OF PROJECT** | **$228,312,000** |
| **ANNUAL COST** | |
| Debt Service (3.5 percent, 20 years) | $16,064,000 |
| Reservoir Debt Service (3.5 percent, 40 years) | $0 |
| Operation and Maintenance | |
| Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities) | $1,422,000 |
| Intakes and Pump Stations (2.5% of Cost of Facilities) | $599,000 |
| Dam and Reservoir (1.5% of Cost of Facilities) | $0 |
| Water Treatment Plant | $0 |
| Advanced Water Treatment Facility | $0 |
| Pumping Energy Costs (19252530 kW-hr @ 0.08 $/kW-hr) | $1,540,000 |
| Purchase of Water (20830 acft/yr @ 500 $/acft) | $10,415,000 |
| **TOTAL ANNUAL COST** | **$30,040,000** |
| **Available Project Yield (acft/yr)** | 20,830 |
| **Annual Cost of Water ($ per acft), based on PF=2** | $1,442 |
| **Annual Cost of Water After Debt Service ($ per acft), based on PF=2** | $671 |
| **Annual Cost of Water ($ per 1,000 gallons), based on PF=2** | $4.43 |
| **Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=2** | $2.06 |

*HK and JMP* *10/6/2019*